infiltration of precipitation over the undisturbed 95 percent of the Calvert Bluff Formation outcrop and from infiltration of water from the end lakes. Based on studies conducted at the Sandow Mine, resaturation of reclaimed spoil typically is achieved within 20 to 30 years following the completion of reclamation (Pollock 1982), suggesting that water levels in the Calvert Bluff Formation near the reclaimed Sandow Mine pits have reached approximately 90 percent of their pre-mining levels. Away from the mined area and downdip in the artesian portion of the Calvert Bluff, it is anticipated that recovery of groundwater levels may take approximately 100 years due to the slow migration of recharge water through the Calvert Bluff silts and clays.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in a minor change in the dewatering pumpage rates (see page 2-21 of the Final EIS). However, the minor change in pumpage rate would not change the projected mine-related groundwater drawdown in the Calvert Bluff aquifer. (See the response to general comment GW-11 in Section 4.5.4 of the Final EIS relative to the sensitivity of groundwater drawdown impacts to pumpage rates.)

Simsboro Aquifer Depressurization. Depressurization wells would be installed incrementally over the life of the mine to reduce the head pressure in the artesian Simsboro aquifer to prevent floor heaving in the advancing pit. These wells would be screened in the upper portions of the Simsboro Formation beneath the lowest lignite seam to be mined. Alcoa only would pump a sufficient quantity of groundwater from the Simsboro aquifer (increasing over time to a maximum of 11,000 acre-feet per year) to reduce the artesian head pressure to a level that would permit mining of the lowest targeted lignite zones. If municipal pumpage in the Simsboro aquifer from adjacent counties should contribute to a reduction in the artesian head pressure in the Three Oaks Mine area, then Alcoa would pump less groundwater from the Simsboro to maintain the lowered artesian head pressure. As a result, Alcoa may not need to pump up to the estimated maximum of approximately 11,000 acre-feet per year of groundwater from the Simsboro aquifer to maintain the required artesian head pressure. Modeling of groundwater drawdown in the Simsboro aquifer assumed that Alcoa would pump up to a maximum of approximately 10,000 acre-feet per year from the Simsboro aquifer. An increase of approximately 1,000 acre-feet per year in the maximum pumpage (up to the projected approximately 11,000 acre-feet per year) would have a minimal change in effect to wells and no change in effect to resources associated with the Simsboro outcrop.

Based on data from existing monitoring wells in the proposed Three Oaks Mine area, the current (year 2000) potentiometric surface in the Simsboro aquifer ranges from 400 to 540 feet NGVD. In the outcrop area to the west of the proposed mine, the water levels range from 460 to 540 feet NGVD (**Figure C-6** in Appendix C). Depressurization pumpage would begin at a rate of approximately 3,428 acre-feet per year (2,125 gpm), with the pumpage volume increasing to approximately 10,889 acre-feet per year (6,750 gpm) as the mine advances downdip (Alcoa 2001c [Volume 4]). As previously discussed under Numerical Groundwater Flow Modeling, groundwater modeling has been used to estimate the projected drawdown in the Simsboro aquifer as a result of depressurization at the Three Oaks Mine. **Table 3.2-3** and **Figure 3.2-8** summarize the results of this modeling. The cross-section in **Figure 3.2-7** illustrates the relationship between drawdown in the Simsboro aquifer and the potential drawdown in private wells screened within the Simsboro aquifer at various distances from the proposed Three Oaks Mine.

Simsboro aquifer following the completion of mining (approximately year 2030) and assuming no additional pumpage for other purposes, the potentiometric surface of the aquifer should recover to 90 percent of pre-mining levels within approximately 40 years and 100 percent of pre-mining levels within approximately 100 years (Alcoa 2000 [Volume 10]).

Pumping of depressurization wells would result in a direct impact to water quantity for private and municipal wells that are screened in the Simsboro aquifer and are located within the anticipated drawdown area. The degree of impact would vary depending on the location of a well in relation to the drawdown area. Wells within the area of 20 feet of drawdown may experience sufficient drawdown to require modification of the pump, or depth of pump placement, in order to continue to provide a sufficient supply of water for domestic or municipal use. Wells within the 50-foot or greater drawdown area would be expected to require modification or replacement. Alcoa's proposed groundwater monitoring plan is described in **Table 2-15**. Additional mitigation may be appropriate to provide ~~baseline and~~ operational monitoring data for evaluation of potential mine-related impacts to existing wells within the modeled LOM 20-foot drawdown area of the Simsboro aquifer (see **Figure 3.2-8**) (see mitigation measure~~s GW-1 and~~ GW-2 in ~~Section 3.2.4, Monitoring and Mitigation Measures~~ ***Table 2-15 of the Final EIS***). If mine-related impacts to private or municipal wells are identified, Alcoa would mitigate the impact as required by the RRC.

The Simsboro aquifer typically is hydraulically separated from any lower Calvert Bluff channel sands by an approximately 60-foot-thick clay zone as well as numerous other clay zones in the Calvert Bluff of very low permeability. These clay zones effectively isolate the Simsboro aquifer from the channel sands in the Calvert Bluff, as shown by multi-well aquifer tests (Alcoa 2000 [Volume 4]). The Carrizo aquifer, which overlies the Calvert Bluff aquifer, is separated from the Simsboro by the same 60-foot-thick clay zone as well as 200 to over 400 feet of low permeability clay in the Calvert Bluff Formation. As a result, groundwater drawdown associated with depressurization of the Simsboro aquifer is not projected to affect groundwater levels in the Calvert Bluff or Carrizo aquifers.

Due to the hydraulic separation of the Simsboro aquifer from the Calvert Bluff aquifer and the determination that the Simsboro physically would not be disturbed under the Proposed Action, groundwater recovery in the outcrop area following the completion of mining partly would be dependent on recharge in the outcrop zone of the formation from infiltration of precipitation. RWHA (Alcoa 2000 [Volume 10]) used the numerical groundwater flow model developed for the Three Oaks Mine to estimate the time required for the Simsboro aquifer to recover from mining operations. Modeling results project that the Simsboro aquifer would reach approximately 90 percent of its pre-mining groundwater level in approximately 40 years following the completion of mining and the cessation of associated depressurization pumping. It is anticipated that complete recovery of the aquifer would take approximately 100 years.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in a minor change in the depressurization pumpage rates (see page 2-21 of the Final EIS). However, the minor change in pumpage rate would not change the projected mine-related groundwater drawdown in the Simsboro aquifer. (See the response to general comment GW-11 in Section 4.5.4 of the Final EIS relative to the sensitivity of groundwater drawdown impacts to pumpage rates.)

Groundwater Quality Impacts.

Groundwater monitoring would be conducted in compliance with Alcoa's RRC mine permit. The groundwater monitoring requirements are summarized in Tables C-5a and C-5b on page C-10a in Appendix C of the Final EIS.

meet the regulatory definition of a hazardous waste. As a result, burial of bottom ash in the reclaimed pits should not degrade water in the nearby undisturbed Calvert Bluff aquifer.

Simsboro Aquifer. There would be no impacts to groundwater quality in the Simsboro aquifer as a result of depressurization activities. Due to the hydraulic separation between the Simsboro and Calvert Bluff aquifers as discussed above in Groundwater Quantity Impacts, mining and subsequent backfill of the mine pits would have no impact on groundwater quality in the Simsboro aquifer.

Carrizo Aquifer. As the Carrizo aquifer occurs outside of the permit area (approximately 3 miles to the southeast) and is hydraulically separated from the lower Calvert Bluff and Simsboro aquifers, there would be no impact to groundwater quality in the Carrizo aquifer as a result of the Proposed Action.

No Action Alternative

Under the No Action Alternative, the Three Oaks Mine would not be developed. As a result, impacts to groundwater quantity and quality resulting from the proposed Three Oaks Mine as described above would not occur. Annual and seasonal changes in groundwater level and groundwater quality characteristics would continue as they have in the past, as would changes associated with municipal pumpage.

Alternative Mine Plan

Under the Alternative Mine Plan, potential mine-related impacts to groundwater quantity and quality would be the same as described for the Proposed Action (see Section 3.2.3.2 of the Draft EIS).

3.2.3.3 Cumulative Groundwater Impacts

Cumulative Impact Assessment Methodology

Potential cumulative groundwater impacts would be associated with pumpage of groundwater at the existing Sandow and proposed Three Oaks Mines by Alcoa; past, present, and reasonably foreseeable future municipal groundwater pumpage in the Brazos G Regional Water Planning Area (Region G); municipal pumpage of groundwater from counties adjacent to the lower basin area of Region G; and the SAWS contracts with Alcoa and CPS for up to 66,000 acre-feet per year of water from the Sandow and Three Oaks areas (see Section 2.6).

Historical Water Use. Historical water use in Texas has been summarized by the TWDB and is available from their website (www.twdb.state.tx.us). Data for the counties in the lower basin area of Region G and adjacent counties of Region H, Region I, and Region K are presented in **Table 3.2-4**. Water use in Texas, especially in the Region G area, has been related to population growth and water conservation measures. In some counties, water use has declined due to population declines or water conservation. Projections of future water consumption are based on past water use trends in a county, estimated future population growth or decline, and estimated water conservation measures.

Table 3.2-5
Estimated Groundwater Demand for Lower Basin Area of Region G and Adjacent Counties[1]
(acre-feet per year)

	Year						
County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**Aquifer**
Region G							
Brazos County							
Municipal demand	43,694	49,366	54,961	58,822	63,346	67,355	Carrizo-Wilcox (Simsboro)
Manufacturing demand	194	221	244	262	295	329	Brazos River alluvium
Steam electric demand	3,350	3,350	3,350	3,350	3,350	3,350	Brazos River alluvium/Bryan
Mining demand	27	27	28	30	32	34	Sparta
Irrigation demand	0	0	0	0	0	0	Brazos River alluvium
Livestock demand	985	985	985	985	985	985	Gulf Coast/Queen City/Sparta
Estimated total groundwater demand	48,250	53,949	59,568	63,449	68,008	72,053	
Estimated groundwater demand Carrizo-Wilcox	43,599	48,772	53,848	57,535	62,326	66,644	
Burleson County							
Municipal demand	2,196	2,244	2,295	2,357	2,397	2,518	Carrizo-Wilcox
Manufacturing demand	131	145	158	171	182	194	Carrizo-Wilcox
Steam Electric demand	0	0	0	0	0	0	
Mining demand	29	24	18	15	13	13	Queen City/Sparta
Irrigation demand	1,032	757	492	239	14	0	Brazos River alluvium
Livestock demand	1,318	1,318	1,318	1,318	1,318	1,318	Carrizo-Wilcox/Queen City
Estimated total groundwater demand	4,706	4,488	4,281	4,100	3,924	4,043	
Estimated groundwater demand Carrizo-Wilcox	6,409	6,471	6,535	6,610	6,661	6,794	
Grimes County							
Municipal demand	2,778	2,923	3,067	3,237	3,128	3,441	Gulf Coast aquifer
Manufacturing demand	280	314	351	391	435	483	Gulf Coast aquifer
Steam electric demand	0	0	0	0	0	0	Brazos River/Livingston Lake
Mining demand	273	255	236	219	213	212	Gulf Coast aquifer
Irrigation demand	0	0	0	0	0	0	Gulf Coast aquifer
Livestock demand	1,933	1,933	1,933	1,933	1,933	1,933	Gulf Coast aquifer
Estimated total groundwater demand	5,264	5,425	5,587	5,780	5,709	6,069	
Estimated groundwater demand Carrizo-Wilcox	122	122	122	122	122	122	
Lee County							
Municipal demand	3,226	3,383	3,521	3,687	3,877	4,150	Carrizo-Wilcox
Manufacturing demand	6	7	8	9	11	12	Queen City
Steam electric demand	0	0	0	0	0	0	
Mining demand	0	5,000	5,000	5,000	0	0	Carrizo-Wilcox
Irrigation demand	275	268	261	254	247	240	Carrizo-Wilcox
Livestock demand	1,711	1,711	1,711	1,711	1,711	1,711	Carrizo-Wilcox
Alcoa SAWS contract	0	0	0	0	7,500	7,500	Carrizo-Wilcox
Estimated total groundwater demand	5,218	10,369	10,369	10,369	13,346	13,613	

Table 3.2-5 (Continued)

	Year						
County	**2000**	**2010**	**2020**	**2030**	**2040**	**2050**	**Aquifer**
Estimated total groundwater demand	6,782	7,648	8,359	9,999	9,158	9,872	
Estimated groundwater demand Carrizo-Wilcox	833	833	833	833	833	833	
Anderson County							
Municipal demand	9,883	10,469	10,957	11,486	11,904	12,537	Carrizo-Wilcox/Queen City
Manufacturing demand	153	164	172	179	194	208	Carrizo-Wilcox/Palestine Lake
Steam electric	11,209	11,209	11,209	11,209	11,209	11,209	Lake Palestine surface water
Mining demand	252	168	93	61	40	31	Carrizo-Wilcox
Irrigation demand	484	484	484	484	484	484	Carrizo-Wilcox/Queen City
Livestock demand	2,138	2,138	2,138	2,138	2,138	2,138	Carrizo-Wilcox/Queen City
Estimated total groundwater demand	24,119	24,632	25,053	25,557	25,969	26,607	
Estimated groundwater demand Carrizo-Wilcox	8,114	8,041	7,974	7,949	7,943	7,948	

[1]For purposes of this summary table, all pumpage for SAWS from the Sandow Mine (40,000 acre-feet per year) was placed in Milam County; however, a portion of the pumpage would come from Lee County. For EIS groundwater modeling purposes, the 40,000 acre-feet per year of pumpage was distributed equally among all active wells at Sandow, including active wells located in Lee County.

Note: Region I groundwater from Carrizo-Wilcox is calculated based on other water sources listed and assumption that remaining groundwater comes from Carrizo-Wilcox.
Mining demand for Lee, Bastrop, and Milam Counties based on data from Alcoa for the existing Sandow Mine and proposed Three Oaks Mine. Three Oaks Mine and SAWS-related pumpage divided equally between Lee and Bastrop Counties.

Source: Alcoa 2000 (Volume 4); TWDB 2002b.

Table 3.2-6
Summary of Estimated Cumulative Groundwater Impacts

Carrizo-Wilcox Aquifer	Calvert Bluff Aquifer	Simsboro Aquifer
Groundwater Levels in Year 2000		
	Groundwater levels range from 440 to 600 feet ***NGVD***. Most levels in the Three Oaks Mine area range from 440 to 460 feet ***NGVD***.	Regional groundwater levels range from 400 to 540 feet ***NGVD***. Levels in the outcrop area range from 460 to 540 feet ***NGVD***. Levels in the Three Oaks Mine area range from 400 to 440 feet ***NGVD***.
Cumulative Impact Scenarios		
Regional Municipal Groundwater Use Plus Three Oaks Mine (Three Oaks without SAWS)		
Year 2030		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	10 to 20 feet of drawdown in Three Oaks Mine area. Represents average impact for entire Calvert Bluff aquifer.	70 to 80 feet of drawdown in the Three Oaks Mine area.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 feet or less of drawdown in outcrop area. Average for entire Calvert Bluff aquifer.	20 to 50 feet of drawdown in the outcrop area west of Three Oaks Mine.
Colorado River and Bastrop County	10 feet or less of drawdown near Colorado River.	20 to 50 feet of drawdown. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***
Year 2050		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	10 feet or less of drawdown averaged over entire Calvert Bluff aquifer.	Average of approximately 60 feet of drawdown.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 feet or less of drawdown averaged over entire Calvert Bluff aquifer.	20 to 50 feet of drawdown. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***
Colorado River and Bastrop County	10 feet or less of drawdown.	20 to 50 feet of drawdown.
Regional Municipal Groundwater Use Plus Three Oaks Mine and SAWS (Three Oaks with SAWS)[1]		
Year 2030		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	20 feet of drawdown near the Three Oaks Mine.	60 to 100 feet of drawdown at Three Oaks Mine. 100 to 140 feet of drawdown at Sandow Mine.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 to 20 feet of drawdown averaged over entire Calvert Bluff aquifer.	30 to 50 feet of drawdown in outcrop west of Three Oaks Mine. 40 to 100 feet of drawdown in outcrop west of Sandow Mine.
Colorado River and Bastrop County	10 feet of drawdown at Colorado River.	10 to 50 feet of drawdown in Bastrop County near Colorado River. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***

Table 3.2-6 (Continued)

Carrizo-Wilcox Aquifer	Calvert Bluff Aquifer	Simsboro Aquifer
Year 2050		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	10 feet or less of drawdown.	100 to 180 feet of drawdown at Three Oaks Mine. 180 to 230 feet of drawdown at Sandow Mine.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 feet or less of drawdown.	70 to 100 feet of drawdown west of Three Oaks Mine. 100 to 180 feet of drawdown west of Sandow Mine.
Colorado River and Bastrop County	10 feet of drawdown averaged over entire Calvert Bluff aquifer.	10 to 80 feet of drawdown. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***
Regional Municipal Groundwater Use Plus Saws Pumpage (No Action Alternative – SAWS without Three Oaks)[1]		
Year 2030		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	10 feet of drawdown.	70 to 130 feet of drawdown at Three Oaks Mine. 100 to 140 feet of drawdown at Sandow Mine.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 feet of drawdown.	40 to 70 feet of drawdown west of Three Oaks Mine. 50 to 100 feet of drawdown west of Sandow Mine.
Colorado River and Bastrop County	10 feet of drawdown.	10 to 50 feet of drawdown. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***
Year 2050		
Three Oaks Mine and vicinity (Milam, Lee, and Bastrop Counties)	10 feet of drawdown.	100 to 210 feet of drawdown at Three Oaks Mine. 200 to 240 feet of drawdown at Sandow Mine.
Outcrop area in Milam, Lee, and Bastrop Counties near Three Oaks Mine	10 feet of drawdown.	70 to 100 feet of drawdown west of Three Oaks Mine. 100 to 200 feet of drawdown west of Sandow Mine.
Colorado River and Bastrop County	10 feet of drawdown.	10 to 80 feet of drawdown. ***Up to 20 feet of drawdown where Colorado River crosses Simsboro outcrop.***

[1]Under the Three Oaks plus SAWS scenario, pumpage for SAWS from the Three Oaks site during the LOM would vary depending on the volume of depressurization pumpage required (increasing up to a maximum of 11,000 acre-feet per year) (conservatively modeled at 10,000 acre-feet per year during the LOM). Under the SAWS without Three Oaks scenario, SAWS pumpage from the Three Oaks site would be greater (15,000 acre-feet per year) during the same period. As a result, drawdown would be slightly greater under the SAWS without Three Oaks scenario.

in the Simsboro aquifer outcrop west of the Three Oaks Mine. Drawdown at the Colorado River is projected to be approximately 20 to 50 feet.

The Colorado River crosses the outcrop of the Simsboro Formation over a 2-mile stretch of the river in Bastrop County. In this area, the Simsboro aquifer may provide baseflow to the Colorado River during times of low flow. During times of high flow, the Colorado River may recharge the Simsboro aquifer through infiltration of stream water. The estimated cumulative water table decline in the Simsboro in the vicinity of this 2-mile stretch where the Simsboro and the Colorado River interact is up to 20 feet. This drawdown may slightly reduce the groundwater gradient in the Simsboro aquifer and thus may slightly reduce the baseflow to the Colorado River during times of low flow. This reduction in baseflow, if it should occur, probably would not be measurable. During periods of high water flow in the Colorado River, recharge of the Simsboro aquifer by the river may offset the decline in the groundwater gradient in the Simsboro near the river and may negate the up to 20-foot drawdown projected for the area by groundwater modeling. Thus, it appears unlikely that adverse impacts would occur to the Colorado River due to a possible decline of up to 20 feet in the groundwater table in the Simsboro aquifer near the Colorado River where the river interacts with the Simsboro aquifer.

For comparison, the direct impacts to groundwater drawdown in the Simsboro aquifer (100 to 200 feet) in the Three Oaks Mine area (**Table 3.2-3** and **Figure 3.2-8**) are projected to be greater than the cumulative impacts projected by the Modified Region G Model due to the greater detail (small cell size) of the Three Oaks LOM Model that was used for modeling direct impacts in the mine area. The Modified Region G Model used for cumulative impacts has large cells (1 mile x 1 mile), averages drawdown over the entire cell and has less detail such as faulting which affects drawdown. This averaging and absence of site-specific detail results in an overall smaller projected drawdown in the Three Oaks Mine area.

Drawdown in the Simsboro aquifer for year 2050 (**Figure 3.2-12**) is projected to be approximately 60 feet in the Three Oaks Mine area and 20 to 50 feet in the outcrop area west of the Three Oaks Mine. Drawdown at the Colorado River also is projected to be approximately 20 to 50 feet. ***Drawdown in the Simsboro aquifer at the Colorado River where the river crosses the Simsboro outcrop is projected to be up to 20 feet.***

Three Oaks with SAWS

The maximum effect of groundwater use from the Carrizo-Wilcox aquifer system is modeled in this cumulative impact scenario. The Three Oaks Mine would initiate pumpage in approximately year 2004 and end in approximately year 2030. A portion of the groundwater from the Three Oaks Mine would go to SAWS starting in approximately year 2013 (up to a maximum of 11,000 acre-feet per year from the Simsboro aquifer). SAWS pumpage from the Simsboro aquifer in the Three Oaks Mine area would increase to 15,000 acre-feet per year in approximately year 2031. The Sandow Mine will cease mining operations in approximately year 2005; however, it will continue pumping 5,000 acre-feet per year for power plant use through year 2030. Pumpage for SAWS would begin in the Sandow Mine area in approximately 2013, and wells in the Simsboro would begin pumping approximately 40,000 acre-feet per year until year 2050. It should be noted that the quantity of water pumped for SAWS would correspondingly reduce the quantity of water pumped for mine depressurization. Regional municipal pumpage was based on the estimated

approximately 10 to 50 feet. ***Drawdown in the Simsboro aquifer where the Colorado River crosses the Simsboro outcrop is projected to be up to 20 feet.*** (See the discussion under Cumulative Groundwater Scenarios in Section 3.2.3.3 relative to potential reductions in Three Oaks Mine depressurization pumpage based on municipal and SAWS-induced drawdown in the Simsboro aquifer.)

For year 2050 (**Figure 3.2-16**), projected drawdown in the Simsboro aquifer in the Three Oaks Mine area would be approximately 100 to 180 feet, and projected drawdown near the Sandow Mine would be approximately 180 to 230 feet. Projected drawdown in the Simsboro outcrop area west of the Three Oaks Mine would be approximately 70 to 100 feet, and projected drawdown in the outcrop area west of the Sandow Mine would be approximately 100 to 180 feet. Projected drawdown at the Colorado River in Bastrop County would be approximately 10 to 80 feet. ***Drawdown in the Simsboro aquifer where the Colorado River crosses the Simsboro outcrop is projected to be up to 20 feet.***

SAWS without Three Oaks (No Action Alternative)

This cumulative impact scenario depicts regional municipal groundwater demand in the Carrizo-Wilcox aquifer system with the addition of the proposed SAWS pumpage in the area of the existing Sandow Mine and in the area of the proposed Three Oaks Mine. Although the Three Oaks Mine would not be developed under this scenario, wells would be installed at the proposed mine site to provide for SAWS pumpage. SAWS pumpage would begin in approximately year 2013 with 40,000 acre-feet per year of pumpage from the Simsboro aquifer in the Sandow Mine area and 15,000 acre-feet per year of pumpage from the Simsboro aquifer in the area of the proposed Three Oaks Mine. This pumpage would continue to approximately year 2050 and potentially beyond. **Table 3.2-6** summarizes the model results of this cumulative impact scenario.

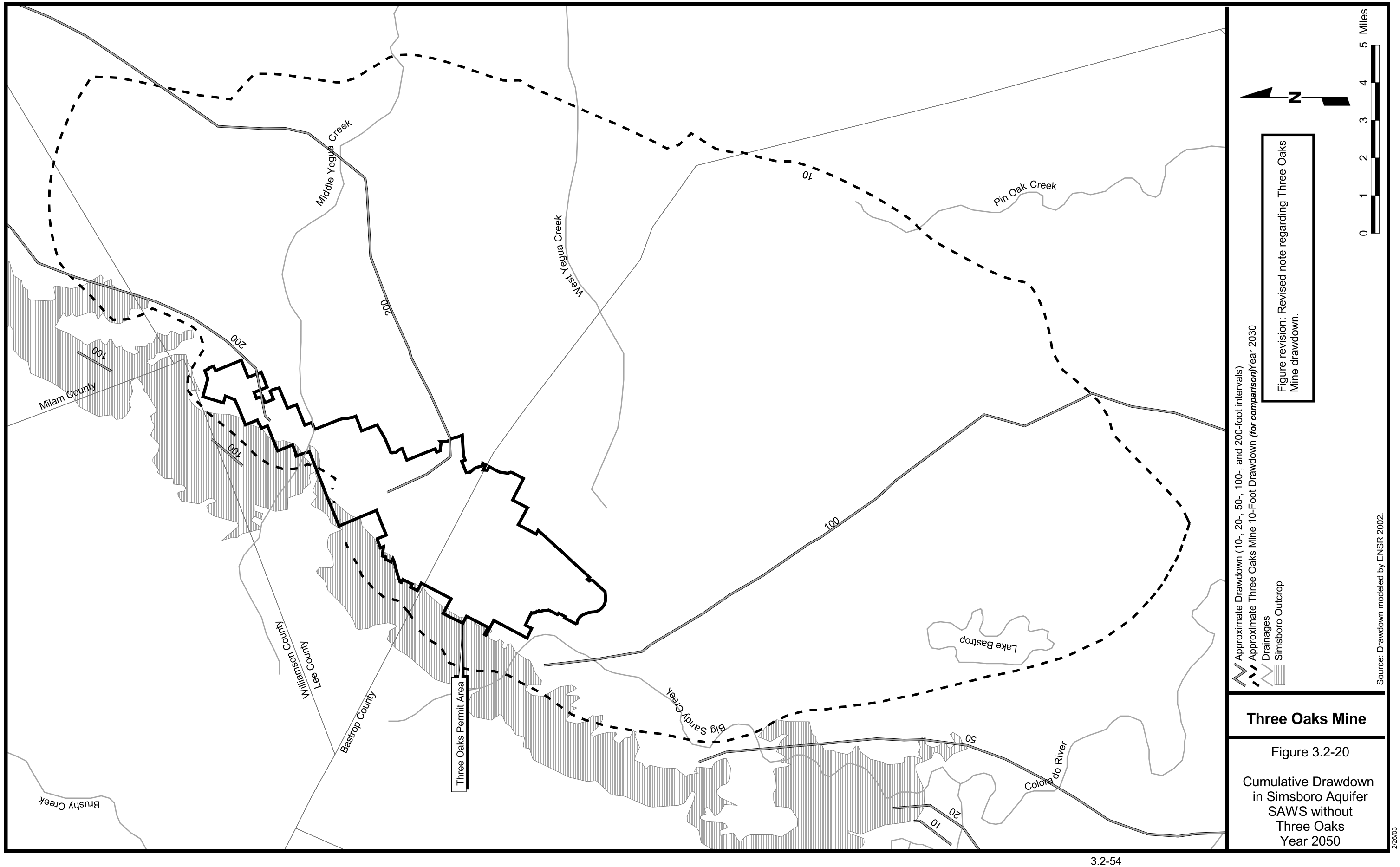
Cumulative Drawdown in the Calvert Bluff Aquifer. For year 2030 (**Figure 3.2-17**), approximately 10 feet of drawdown in the Calvert Bluff aquifer is projected near the Colorado River in Bastrop County due to regional pumpage in the Calvert Bluff in Bastrop County. Approximately 10 feet or less of drawdown is projected to occur in the Calvert Bluff outcrop area near the Three Oaks and Sandow Mine areas.

For year 2050 (**Figure 3.2-18**), drawdown in the Calvert Bluff is projected to be approximately 10 feet at the Colorado River due to regional pumpage.

Cumulative Drawdown in the Simsboro Aquifer. For year 2030 (**Figure 3.2-19**), drawdown in the vicinity of the Three Oaks Mine is projected to be approximately 70 to 130 feet largely due to SAWS pumpage in the Three Oaks Mine area. Drawdown in the Sandow Mine area is projected to be approximately 100 to 140 feet. Drawdown in the outcrop area west of the Three Oaks Mine is projected to be approximately 40 to 70 feet, and drawdown in the outcrop area west of the Sandow Mine is projected to be approximately 50 to 100 feet. Drawdown at the Colorado River in Bastrop County is projected to be approximately 10 to 50 feet. ***Drawdown in the Simsboro aquifer where the Colorado River crosses the Simsboro outcrop is projected to be up to 20 feet.***

For year 2050 (**Figure 3.2-20**), drawdown in the vicinity of the Three Oaks Mine is projected to be approximately 100 to 210 feet; in the vicinity of the Sandow Mine, drawdown is projected to be approximately 200 to 240 feet. Drawdown in the outcrop area west of the Three Oaks Mine is projected to

be approximately 70 to 100 feet, and drawdown in the outcrop area west of the Sandow Mine is projected to be approximately 100 to 200 feet. Drawdown at the Colorado River is projected to be approximately 10 to 80 feet. ***Drawdown in the Simsboro aquifer where the Colorado River crosses the Simsboro outcrop is projected to be up to 20 feet.***


Middle Yegua Creek
West Yegua Creek
Pin Oak Creek
10
200
100
Milam County
Lee County
Williamson County
Bastrop County
Three Oaks Permit Area
Big Sandy Creek
Lake Bastrop
Colorado River
50
20
10
Brushy Creek
N
0 1 2 3 4 5 Miles
Approximate Drawdown (10-, 20-, 50-, 100-, and 200-foot intervals)
Approximate Three Oaks Mine 10-Foot Drawdown (for comparison)Year 2030
Drainages
Simsboro Outcrop
Source: Drawdown modeled by ENSR 2002.
Figure revision: Revised note regarding Three Oaks Mine drawdown.
Three Oaks Mine
Figure 3.2-20
Cumulative Drawdown in Simsboro Aquifer SAWS without Three Oaks Year 2050
2/26/03

Section 3.2.3.2. Groundwater quality in the Simsboro aquifer is good throughout the cumulative effects area. Groundwater quality in the Calvert Bluff aquifer in the cumulative effects area generally is not suitable for domestic use.

3.2.3.4 Monitoring and Mitigation Measures

GW-1: Baseline Monitoring~~. Groundwater level monitoring would begin in the Simsboro outcrop area to the west of the Three Oaks Mine at least 1 year prior to the commencement of groundwater pumping. The outcrop area encompassed by the mine-related 10-foot or greater drawdown would be monitored. This would provide documentation of baseline conditions for future use in assessing mine-related groundwater drawdown impacts as defined by the Three Oaks groundwater model, and the potential subsequent need for Alcoa to modify or replace existing private wells in accordance with RRC regulations.~~ ***Due to the proposed time frame (less than 1 year following receipt of permits) for initiation of mine-related pumping in the Simsboro aquifer, the USACE has further evaluated the effectiveness of mitigation measure GW-1 as presented in the Draft EIS. Based on this evaluation, the USACE has determined that existing groundwater level data for the Simsboro outcrop area west of the Three Oaks Mine, in addition to implementation of additional monitoring as described in revised mitigation measure GW-2, would provide an adequate baseline for assessing mine-related groundwater drawdown impacts. As a result, the USACE has eliminated mitigation measure GW-1 as presented in the Draft EIS.***

GW-2: ***Monitoring of Depressurization Pumping and*** Operational Well ***Effects***~~Monitoring~~. ~~Groundwater levels~~ ***Water-level changes*** in the Calvert Bluff and Simsboro aquifers would be monitored on a quarterly basis, ~~beginning at least 1-year, if possible, prior to commencement of dewatering and depressurization operations at the Three Oaks Mine. Monitoring well locations would be selected based on: 1) access and land ownership, 2) screened interval of the pumping wells relative to the monitored aquifer, 3) spatial distribution relative to the pumping wells and position within the projected 10-foot drawdown contour for the aquifer, and 4) experience gained in monitoring drawdown impacts at the Sandow Mine.~~ ***within and adjacent to the Three Oaks Mine permit area in the general area where 10 feet or more of drawdown is projected.*** At least five monitoring wells for the Simsboro aquifer would be located in the Simsboro outcrop area to the west of the Three Oaks Mine. ~~These five monitoring wells would encompass the projected range of drawdown in the Simsboro outcrop area out to the projected 10-foot drawdown contour, as presented in Alcoa's RRC permit application, Section .146. A preliminary set of monitor wells also is presented in the RRC permit application in Section .146. For the outcrop area of the Simsboro aquifer, monitor wells would be added to this preliminary list and installed as needed based on landowner permission.~~ Groundwater level and groundwater quality monitoring would comply with RRC guidelines.

Monitoring would be on a quarterly basis for the first 5 years of operation of the Three Oaks Mine. Groundwater monitoring reports would be submitted to the USACE and the RRC ~~annually~~ ***quarterly for the first 2 years and annually thereafter***. At the end of the first 5 years of operation, the Three Oaks LOM Model developed by Alcoa for the Three Oaks Mine would be validated against the observed drawdown in both the Calvert Bluff and Simsboro aquifers. The results of this validation would be supplied to the USACE and the RRC. The Three Oaks LOM Model then would be recalibrated based on the 5-year drawdown data, and projections for the drawdown out to the 10-foot drawdown contour would be made for the remaining life of the mine. A report detailing the recalibration and new projections for the drawdown contours would be submitted to the USACE and RRC.

Following the first *5*-year~~s~~ **monitoring *program,*** of operation, groundwater monitoring in the Calvert Bluff and Simsboro aquifers would be conducted on a semi-annual basis. Reports would be submitted to the USACE and the RRC on an annual basis. The Three Oaks LOM Model would be validated against observed drawdown every 5 years, and the results of the validation would be submitted to the USACE and RRC. The groundwater model would be recalibrated as needed every 5 years, and projections for drawdown out to the 10-foot drawdown contour would be made for the estimated remaining life of the mine. These projections would be submitted to the USACE and RRC in a modeling report.

The position of the projected drawdown contours for the Calvert Bluff and Simsboro aquifers would be used as a guide to determine the potential mine-related impacts of dewatering and depressurization operations on private and municipal wells in these two aquifers near the Three Oaks Mine. These projections would be updated every 5 years based on recalibration of the Three Oaks LOM Model to observed drawdown in these two aquifers.

3.2.3.5 Residual Adverse Effects

There would be temporary residual adverse effects to groundwater quantity as a result of Three Oaks Mine pumping, pending the recovery of groundwater levels in the Simsboro aquifer approximately 40 to 100 years post-mining. The groundwater level in the Simsboro aquifer is anticipated to recover to 90 percent of its pre-mining level in approximately 40 years and to 100 percent in approximately 100 years (Alcoa 2000 [Volume 10]). These estimates appear to be reasonable.

3.2.4 Surface Water

3.2.4.1 Affected Environment

Regional Surface Water Features

Major components of the surface water network in the study area include the Lower Colorado River to the southwest, Somerville Lake to the east, and several streams that transect the region. The latter include Brushy Creek, West Yegua Creek, Middle Yegua Creek, East Yegua Creek, Big Sandy Creek, and numerous tributaries (**Figure 3.2-21**). The study area for surface water resources includes these drainages within the permit area and the projected mine-related 10-foot groundwater drawdown areas within the Simsboro and Calvert Bluff aquifer outcrops, extending downstream to Somerville Lake and the Colorado River at Bastrop, Texas. The cumulative effects area includes these drainages within the permit area and the interrelated actions' projected 10-foot groundwater drawdown areas within the Simsboro and Calvert Bluff aquifer outcrops, extending downstream to Somerville Lake and the Colorado River. Seven USGS stream gages are present within the study area. These are shown in **Figure 3.2-1**, and their mean annual flows are shown in **Table 3.2-7**. Mean monthly flow data for these stations are shown in **Table C-6** in Appendix C.

Monthly streamflow varies substantially at all of the gages in the area. The stream gage on Middle Yegua Creek near Dime Box exemplifies this, as shown in **Table C-7** in Appendix C. Conditions of very low to zero flow often occur in late summer and early fall at this station. ***Middle Yegua Creek at this USGS gage station has a watershed area of approximately 236 square miles and is downstream of both the Simsboro and Carrizo aquifer outcrops. However, the creek was dry for a month or more in approximately half the years of record. Based on a review of daily flow data, average baseflows appear to be on the order of 3 to 5 cfs at this downstream location.*** Late-season low-flow to zero-flow conditions also exist in most streams in the region. In contrast to Middle Yegua Creek, periods of zero-flow are rare at the USGS gage on East Yegua Creek near Dime Box. Both streams historically have been augmented to some degree by pumping discharges from the Sandow Mine. However, these discharges occur approximately 20 miles upstream of the USGS gages, and channel losses ~~are~~ ***can be*** substantial in the area.

Table 3.2-7
Mean Annual Flow at USGS Stream Gages in the Project Region

USGS Gage Name	Gaging Station Identifier	Period of Record (as currently published)	Contributing Area (square miles)	Mean Annual Flow/Area (cfs per square mile) (for period of record)
Brushy Creek near Rockdale	08106300	8/67 – 9/80	505	0.39
Big Sandy Creek near McDade[1]	08159165	7/79 – 9/85	38.7	0.22
Big Sandy Creek near Elgin[1]	08159170	7/79 – 9/85	63.8	0.16
Middle Yegua Creek near Dime Box	08109700	8/62 – 9/00	236	0.24
East Yegua Creek near Dime Box	08109800	8/62 – 9/00	244	0.26
Yegua Creek near Somerville	08110000	6/24 – 9/91	1,009	0.28
Colorado River at Bastrop	08159200	3/60 – 9/00	28,576	0.08

[1]The USGS station on Big Sandy Creek near McDade is upstream of the station near Elgin.

Source: USGS 2001.

pumping from the northern portions of the Sandow Mine. Approximate Sandow Mine discharges have been estimated as shown in Appendix C, **Table C-8**.

Although the USGS gages on Big Sandy Creek were discontinued in the mid-1980s (see Table 3.2-7 of the Draft EIS), their periods of record include years of somewhat low and somewhat high precipitation rates relative to the regional average. An examination of the daily streamflow records for November through January was conducted for the USGS gages on Big Sandy Creek (gages 08159165 and 08159170). These months were selected because precipitation and evapotranspiration are likely to be the lowest, and an indication of baseflow rates can be more readily ascertained from the daily data. Based on this review, average stream baseflows ranged between 0.5 to 1.0 cfs at the upstream station (Big Sandy Creek near McDade), and between 0.5 to 1.5 cfs at the downstream station (Big Sandy Creek near Elgin).

During large precipitation events, the flows in regional channels rise rapidly. For example, in sharp contrast to the average flows, the peak annual flows for Middle Yegua Creek near Dime Box have frequently been on the order of 2,000 to 6,000 cubic feet per second (cfs). In May 1975 and during the December 1991 storm event, the recorded peak flows were 11,400 and 12,500 cfs, respectively. Consistent with the wide variation characteristic of the region, a number of annual peak flows at the station are less than 1,000 cfs and some are less than 100 cfs (USGS 2001).

It should be noted that flows in the Colorado River at Bastrop are particularly influenced by storage and release schedules on large reservoirs upstream and by numerous diversions. Also of note is the lower flow per unit watershed area along Big Sandy Creek from the USGS gage near McDade downstream to the USGS gage near Elgin.

Major reservoirs in the region include Somerville Lake, a USACE project near Somerville; the Highland Lakes on the Colorado River above Austin; and Lake Bastrop on a tributary to Piney Creek near the City of Bastrop. The Highland Lakes, the largest of which are Lake Travis, ~~Lake LBJ,~~ and Lake Buchanan, are

101,584 acre-feet in October 2000. More typically, recent storage has been approximately 130,000 to 160,000 acre-feet (USACE 2001).

Local Surface Water Features

Within and near the proposed mine permit area, the major drainages include Middle Yegua Creek (in the Brazos watershed) and Big Sandy Creek (in the Colorado watershed). Local tributaries to Middle Yegua Creek include Willow Creek, Mine Creek, and Marshy Branch. Burlson Creek, Little Sandy Creek, and Chocolate Creek are tributaries to Big Sandy Creek. These local area streams are shown in **Figure 3.2-21**. Near the permit area, creeks and streams are generally classified as intermittent with some ephemeral segments. ~~TNRCC has classified Middle Yegua Creek as intermittent with perennial pools. TNRCC has tentatively classified all other tributaries within the permit area as intermittent with no perennial pools (Davenport 2001).~~ ***The reach of Middle Yegua Creek in the vicinity of the proposed permit area has been tentatively classified by TCEQ as being intermittent with perennial pools. All other tributaries within the proposed permit area have been classified by TCEQ as intermittent with no perennial pools (Davenport 2001). Short perennial reaches also have been identified in the general project area through site-specific inventories. These perennial reaches are indicated in Figure 3.2-21 of the Draft EIS.***

Stream channels in the permit area have average main channel gradients ranging from approximately 10 to 50 feet per mile. Channel cross-sections are typically incised, with eroded cutbanks transitioning to flatter adjoining floodplains and overbank terraces. Bank material grain sizes range from clays to gravels depending on site-specific geologic formations (both underlying and upstream) and in-channel flow velocities (Alcoa 2000 [Volume 5]). Channel banks typically are vegetated and are considered stable with only minor erosion occurring at some locations.

Alcoa is conducting a flow measurement and sampling program on streams in and near the permit area (Alcoa 2000 [Volume 5]). RRC regulations require a minimum program duration of 1 year for a surface coal mining permit application. Alcoa's program has been ongoing since late April 1999 ***and was continued through 2002***. **Figure 3.2-21** shows the monitoring locations for streamflow measurements and water quality sampling. The designated locations are identified in **Table 3.2-8**.

Table 3.2-8
Local Stream Monitoring Sites

Station Identifier	Location
UBS	Upper Big Sandy Creek
LBS	Lower Big Sandy Creek
LLS	Lower Little Sandy Creek just above confluence with Big Sandy Creek
LMC	Lower Mine Creek
UWC	Upper Willow Creek
LWC	Lower Willow Creek at County Road 304
CC	Chocolate Creek
LMY	Lower Middle Yegua Creek at County Road 306
LC	Drainage at County Road 309
I3	Sand Branch - tributary to Cross Creek

Source: Alcoa 2000 (Volume 5).

Flow data for these stations are shown in **Table C-9** in Appendix C. The streamflow measurements indicate that Willow Creek, Mine Creek, and Chocolate Creek are dry most of the time and exhibit little sustained flow. This condition generally indicates that flow in these streams is driven primarily by precipitation events.

This separation from groundwater influence may occur as a result of streambed location above the local groundwater levels, or due to the presence of low-permeability materials that serve to isolate the channels. Either of the two conditions would act in combination with high evapotranspiration demands to limit baseflow. Higher sustained flows were recorded on Big Sandy, Little Sandy, and Middle Yegua Creeks. These streams drain larger watershed areas, which extend onto baseflow-contributing areas overlying the Simsboro aquifer outcrop (Alcoa 2000 [Volume 5]).

Low-flow period investigations were conducted at selected locations along Little Sandy, Big Sandy, and Middle Yegua Creeks and associated tributaries (**Figure 3.2-21**) during the latter half of 1999. Flow measurements are presented in **Table C-9** in Appendix C. The measurements indicate that parts of Little Sandy, Big Sandy, and Middle Yegua Creeks receive groundwater contributions over short segments associated with the Simsboro aquifer outcrop. These short reaches are shown within circled areas on **Figure 3.2-22**. In the upper reaches of Big Sandy Creek, numerous ponds exist that may be contributing seepage to a short reach of the channel. Along all three streams, conditions of zero-flow and dry streambeds were identified within short distances of the gaining segments. Immediately downstream of the proposed permit area, both Big Sandy Creek (site LBS) and Middle Yegua Creek (site LMY) showed zero-flow conditions during the late summer and fall of 1999 (**Figure 3.2-21**). Site LBS is at the location of the discontinued USGS gage 08159165 (Big Sandy Creek near McDade). The USGS data from the early 1980s also showed periods of little or no flow at site LBS during the late summer and early fall (August and September), but consistent with the large precipitation and streamflow variability in the region, there also are periods of higher flows in July, October, and November. Such flow variations also are exhibited from year to year in the baseline inventory data collected for Alcoa.

High-flow period investigations were conducted at measurement sites LMY and LBS (**Figure 3.2-21**). These sites had the largest flows recorded during the data collection program. Crest-stage gages were employed for this part of the investigation. At site LMY, the largest flow estimated was 15.5 cfs ***in late January 2001***. At site LBS, the largest recorded flow was ~~10.64 cfs. Both flows occurred in late January 2001.~~***14.66 cfs in late August 2001.*** Typically, flows at these sites are much smaller (frequently less than 1 cfs), and both creeks ~~showed zero~~ ***exhibit little or no*** flow at these stations ***at some point*** in the late summer and early fall of each year.

~~It should be noted that the water resources inventory for the proposed project has been conducted during drier than average years; somewhat anomalous conditions may be unavoidable in sampling a natural hydrologic system over a limited period. In 1999, rainfall in the area was approximately 60 percent of the long-term average. Streamflows in 1999 at the USGS gages on Middle Yegua and East Yegua Creeks were approximately 50 and 60 percent of their long-term averages, respectively. Available data appear to indicate a dry year at these gages for the year 2000 as well.~~ ***It should be noted that currently the water resources inventory for the proposed project has been conducted for over 3 years. The initial year or so was drier than average years; approximately 60 percent of the long-term average annual rainfall fell in 1999. Subsequent years have been wetter than average years, with approximately 18 percent greater than average annual rainfall in 2000, and 25 percent greater than average annual rainfall in 2001.*** Therefore, when referring to project area conditions, the use of the terms “average”

undisturbed channels (those that do not convey artificially augmented flows) in the region, these streams have historically exhibited flow in close response to precipitation and frequently have little or no flow in late summer and early fall.

Several springs exist near the permit area, approximately 5 miles northeast of McDade in the Middle Yegua and West Yegua Creek drainages ***(see Figure 3.2-22 of the Draft EIS)***. ***Spring locations were identified on the basis of field investigations during the surface water inventory and by reviewing USGS and NWIS (National Wetlands Inventory System) 7.5-minute quadrangle maps during the assessment of potential impacts.*** These ***springs*** include Henderson Spring, Gum Spring, and Darden Spring. Approximately 3 miles farther northeast, an additional unnamed spring occurs adjacent to Middle Yegua Creek, well east of the permit area. All of these springs are located in areas near the Calvert Bluff-Carrizo outcrop boundary. Lawhon Spring is located approximately 0.5 mile northwest of the permit area, near the Hooper-Simsboro outcrop boundary, slightly east of the intersection of the Bastrop-Lee-Williamson County lines. Flow amounts and durations at these locations are unknown, but are likely to be small and intermittent.

Numerous stock ponds of varying sizes occur within the study area and within the proposed permit area. Over 100 stock ponds occur in the proposed permit area, as shown in **Figure 3.2-23**. The density of stock pond occurrence varies substantially in the region, and it appears to be on the order of 5 to 10 ponds per square mile. Most of these ponds have been placed in small tributary drainageways and are supplied by surface runoff. The water levels in these ponds vary throughout the year, with many exhibiting substantial or complete drawdown during droughts. In addition, seeps or wet depressions are distributed throughout the region and in the permit area. These features are typically located in small tributary drainageways; however, many occur on hillslopes or are associated with larger stream channels. Additional description of the distribution of USACE jurisdictional features is presented in Section 3.2.5, Waters of the U.S. Including Wetlands.

Regional Surface Water Quality

TNRCC administers surface water quality regulatory programs in Texas, with substantial involvement from river authorities (such as the LCRA and the Brazos River Authority) and other state and local groups. Activities by these organizations include those conducted under the Texas Clean Rivers Program and other enabling legislation. Groundwater quality is described in Section 3.2.3.1, Groundwater. Surface water quality regulations, standards, criteria, and their application have been promulgated in TAC, Title 30, Chapter 307 (TAC 2000a). Drinking water standards are addressed in TAC Title 30, Chapter 290 (TAC 2000b). In addition, the Colorado River Watershed Protection Rules (30 TAC 311E) (TAC 1986), TPDES permit requirements, and the 401 Certification process also apply to activities that may affect water quality.

Four general categories of use are identified for Texas surface water quality standards. These include aquatic life use, contact recreation, public water supply, and fish consumption. Revised TNRCC regulations provide surface water quality provisions (including anti-degradation) to habitat for aquatic life uses, wetland water quality functions, and discharge of dredged or fill material under Section 401 of the CWA. ***The anti-degradation regulations administered by TCEQ under TAC Title 30, Chapter 279 Water Quality Certification, are found in Section 307.5 of the Texas Surface Water Quality Standards (dated***

April 30, 1997). These regulations stipulate that water quality sufficient to protect existing uses will be maintained. No activities subject to regulatory action that would cause degradation of waters that exceed fishable/swimmable quality will be allowed unless it can be shown to the commission's satisfaction that the lowering of water quality is necessary for economic or social development.

If the USACE issues a Section 404 permit for the Three Oaks Mine, the USACE would send the draft Section 404 decision document to TCEQ, which would have 10 days to 1) request an extension, 2) approve the Section 401 Certification (with or without conditions), or 3) deny the Section 401 Certification. TCEQ staff are required to review the Section 401 Certification application (see Appendix B of the Draft EIS) and make the necessary determination about whether discharges are expected to cause water quality degradation. If degradation is expected, appropriate mitigation measures may be required to minimize or eliminate the degradation. In the event that degradation would result despite the application of appropriate mitigation measures, intergovernmental coordination and public participation would be required in the decision-making process to determine if economic or social development warrants the degradation.

TCEQ has coordinated with the USACE and Alcoa throughout the preparation of the EIS relative to the issuance of a Section 401 Certification. In addition, TCEQ is working directly with Alcoa relative to additional measures that may be required to mitigate potential degradation to downstream aquatic uses specific to a Section 401 Certification.

No stream reaches within the study area are listed in the Texas CWA Section 303(d) list of water bodies that do not meet, or are not expected to meet, water quality standards (TNRCC 2000). According to 30 TAC 307, two classified stream segments exist within the region. These include the Colorado River above LaGrange (Segment 1434) and Somerville Lake (Segment 1212) in the Brazos River basin.

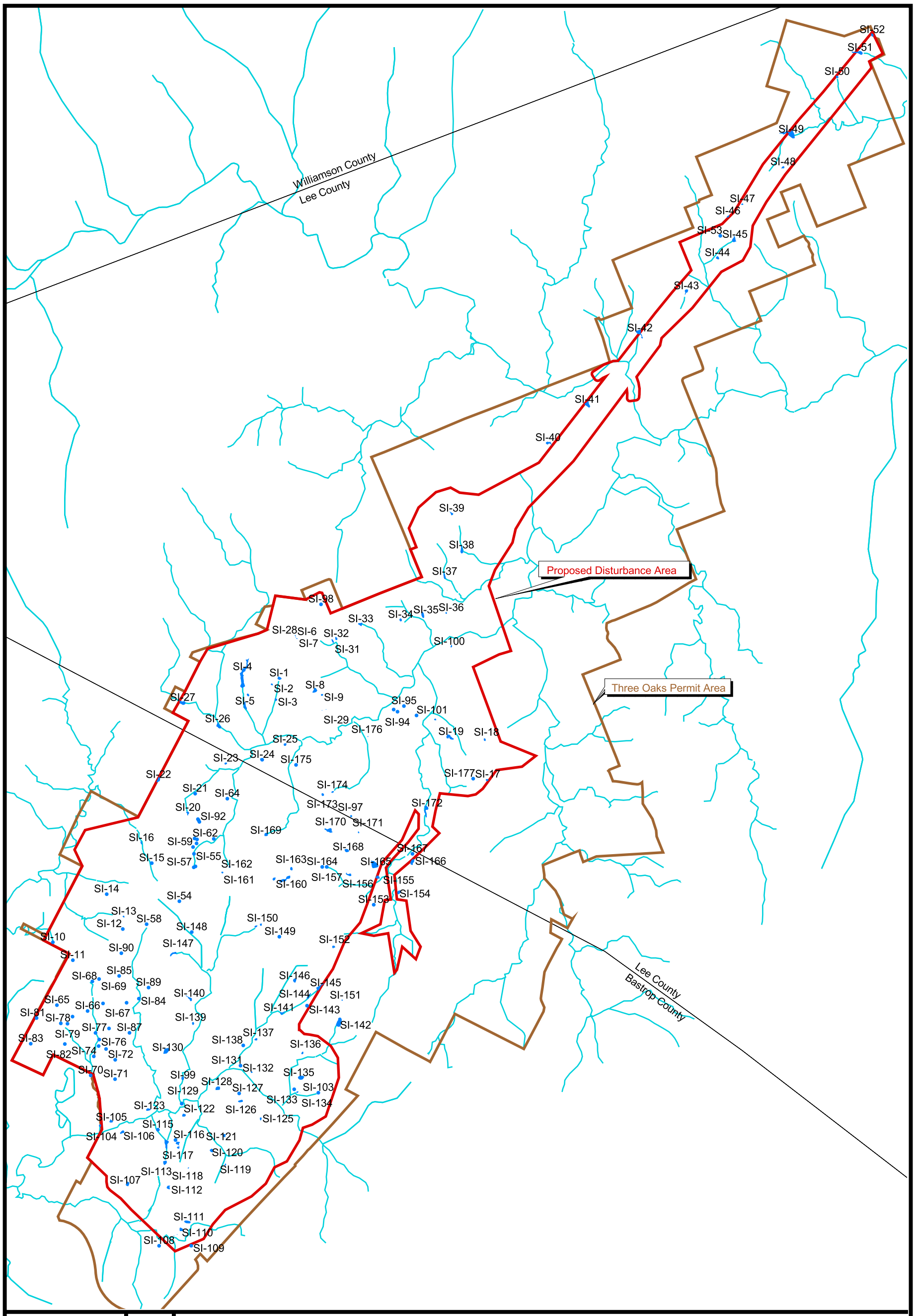


Figure 3.2-23
Surface Water Impoundments

Three Oaks Mine

3.2-64

1/28/03

Site-specific water quality criteria as listed in 30 TAC 307 apply to these segments. Other streams, including East and Middle Yegua Creeks and Big Sandy Creek, are unclassified. Water quality criteria for Segments 1434 and 1212 apply as default criteria for the non-designated stream segments in their respective basins. **Table C-10** in Appendix C indicates surface water criteria for classified stream segments. **Table C-11** in Appendix C indicates surface water criteria for selected toxic constituents for the Brazos and Colorado River basins.

The USGS has conducted water quality sampling ~~in the vicinity of~~ ***at*** stream gages on East Yegua Creek (Station 08109800), Big Sandy Creek near McDade (Station 08159165), ~~and~~ Big Sandy Creek near Elgin (Station 08159170)***, and the Colorado River at Bastrop (Station 08159200)*** (see **Figure 3.2-1**). Alcoa has conducted ~~additional~~ water quality sampling in the vicinity of the existing Sandow Mine as part of monitoring programs for that facility. ~~Regional sampling results generally indicate good water quality, with constituent levels typically within general criteria for the uses.~~ ***In addition, LCRA and the Brazos River Authority have conducted sampling in their respective watersheds within the region, as part of the Texas Clean Water Program.***

USGS data for Big Sandy Creek were analyzed for a number of runoff events in 1979 through 1981. The results show generally good water quality, with few standards exceedences. Chloride, sulfate, and total dissolve solids occasionally were elevated near McDade. Similarly, occasional exceedences occurred for these constituents in USGS data for the Colorado River at Bastrop. Overall water quality at the latter station generally was well within standards over a long sampling period (1968 to 2001).

Within the Brazos watershed, sampling in the late 1990s was conducted on East, Middle, and West Yegua Creeks, on Brushy Creek upstream of Sandow Mine influence, and on Nails Creek and Cedar Creek northeast of Giddings (BRA 2003). The latter two streams flow into the southwestern arm of Somerville Lake. Concentrations of water quality constituents varied widely at all of these sites. Chloride concentrations were between 98 and 135 mg/l approximately half the time on Brushy Creek at FM 908 outside of Rockdale. Substantially elevated chloride and sulfate concentrations occurred on West Yegua Creek at Highway 77, and on Nails and Cedar Creeks just upstream of Somerville Lake. Chloride and sulfate concentrations on Middle and East Yegua Creeks varied widely. Chloride and sulfate ~~concenrtations~~concentrations frequently were elevated above current stream standards on these drainages as well.

Nationwide studies of agricultural runoff water quality indicate that the region falls within the highest 10 to 20 percent of the nation's watersheds in terms of existing impacts from elevated levels of nitrogen and pesticides in runoff (NRCS 1997). Other assessments also identify urban and non-point (i.e., distributed) sources of elevated nitrogen concentrations and other pollutants in the Lower Colorado and Brazos Rivers (TWRI 1991; Jensen 1998). In general, regional water quality data and related agency assessments indicate that water quality in the area has been affected by existing land uses, releases from municipal treatment plants, and geologic factors.

In general, levels for both total and dissolved metals and metalloids (non-metallic elements having some of the chemical properties of metals) are below detection limits at all USGS and privately monitored sites, with the exception of iron, barium, and manganese. Where trace metals were detected, their amounts were often

response to RRC regulations (Alcoa 2000 [Volume 5]). Results of flow monitoring investigations indicate that relatively short perennial reaches probably exist in isolated locations on Big Sandy and Middle Yegua Creek, longer reaches having intermittent flow conditions exist on these streams and some tributaries, and ephemeral conditions are widespread, being typical on most tributaries (see **Figure 3.2-21**). Ephemeral streams flow only in direct response to rainfall/runoff events. In the project region, flow is sustained in such drainages only for short periods, usually a matter of hours or days.

Alcoa has developed a surface water control plan and a monitoring plan for the proposed project. In addition, regulatory processes are required that involve the USACE, TNRCC, and RRC in the review and approval of permit applications and related control measures for surface drainage, discharge, and water quality. The applicability of specific water quality standards and detailed approaches to compliance will be determined during these processes. Compliance monitoring and reporting would be conducted during operations and for a subsequent period to be determined. Review of the permits and practices would be conducted every 3 years as part of the continuing regulatory program. This assessment of potential impacts to surface water resources considers these factors.

Alcoa has conducted surface water quality inventories in the proposed permit area and adjacent downstream areas for the RRC Three Oaks Mine Permit Application. The water quality sampling locations are identified in **Table 3.2-8**. Water quality from the local area inventory generally corresponds to that described for the region. Sampling results from the local area inventory are shown in **Table C-12** in Appendix C. Total and dissolved metals and metalloids were generally below detection limits and within general criteria when detected. ~~Hardness and TDS varied widely. Chloride and sulfate levels were slightly elevated above regional values in some instances, particularly along Chocolate Creek, Lower Big Sandy Creek, Lower Mine Creek, and Lower Middle Yegua Creek.~~ ***Hardness and TDS varied widely, with baseline TDS values exceeding the current respective stream water quality standards (for Colorado River segment 1434 and Somerville Lake segment 1212) approximately 70 percent of the time. Chloride and sulfate levels generally exceeded current respective stream water quality standards, with sulfate almost always exceeding the standards. Further information regarding currently applicable surface water quality standards and the baseline surface water inventory is presented in Appendix C of this Final EIS.*** With few exceptions (notably in February 2001), dissolved oxygen levels were generally acceptable throughout the year for limited aquatic life use (TAC 2001a). The major exception is at Upper Big Sandy Creek (Site UBS) where dissolved oxygen levels were lower. Flow rates at this site are quite low and may be associated with natural groundwater discharge into the channel.

Alcoa has inventoried the majority of the surface water impoundments within the area proposed for mining (Alcoa 2000 [Volume 5]). Sampling results from this inventory are shown in **Tables C-13** and **C-14** in Appendix C. Generally, the water in the surface impoundments was of good quality and suitable for most uses. In some instances, the pH exceeded commonly accepted limits; however, it was generally between 6 and 9 standard units. Specific conductivity was generally lower than stream values during low-flow periods and was generally considerably less than in groundwater from the surrounding Calvert Bluff Formation. This difference would further corroborate the likelihood that most water in the surface impoundments has its origin in surface runoff. Where higher conductivities were identified, they are likely to result from groundwater inflows, evapoconcentration, or from reaction to adjacent geologic strata.

Cities of Rockdale and Lexington (Alcoa 2000 [Volume 5]). In addition, a large number of surface impoundments are located on lands owned by CPS; these are identified in **Table C-14**.

3.2.4.2 Environmental Consequences

Proposed Action

Surface Water Quantity Impacts.

Removal of Surface Water Features. ***Stream channels and small impoundments would be removed as a result of mining. This would create short-term impacts until such features are replaced in accordance with mitigation plans subject to approval under the Clean Water Act, Section 404 requirements. Descriptions of the impacts and proposed mitigation of surface water features are presented below.***

A total of approximately 38 miles (23.6 acres) of existing intermittent and ephemeral streams would be removed through mining or recontouring in the proposed project area. This disturbance would occur incrementally over the life of the mine. The majority of these features (approximately 19.9 acres) consist of small ephemeral drainages that flow only in direct response to rainfall/runoff events. Of the intermittent streams (approximately 3.7 acres), approximately 2,000 feet of Chocolate Creek and 10,000 feet of Willow Creek would be disturbed within the proposed disturbance area. In the mine area, the disturbance or removal of stream channels would be temporary impacts, since drainage features ultimately would be restored during reclamation. In addition, many stream channels would be rerouted during mining, rather than being completely removed. During the active mining period, streams that flow onto the mine area from upstream locations would be rerouted around the disturbance areas or routed through them in clean-water diversions. No direct disturbance would occur on Big Sandy Creek or Middle Yegua Creek, except as needed for access corridor crossings, which are discussed below. After final recontouring, runoff and streamflows from approximately 9,800 acres of watershed area would be routed into end lakes.

Approximately 150 stock ponds occupying approximately ~~69.9~~ ***77.1*** acres would be removed by mining. Of this total pond area, approximately 38.5 acres are on-channel ponds considered to be waters of the U.S. The remaining ~~31.4~~***38.6*** acres consist of non-jurisdictional stock ponds. The removal of stock ponds would create temporary impacts, since restoration of similar features within the project area would occur incrementally during concurrent reclamation. Most of the affected stock ponds currently provide limited wetland values. Mitigation for stream channel disturbance is planned, and may be accelerated early in the project when the lignite is shallower and reclamation could proceed faster. Further descriptions of the extent and mitigation of jurisdictional waters of the U.S., including stream channels, ponds, wetlands, and related habitats, are presented in Section 3.2.5, Waters of the U.S. Including Wetlands.

Alcoa has proposed a draft Mitigation Plan (Appendix E) that addresses reclamation of wetlands, riparian woodland, and surface water features. The reclamation objective is to create features of similar nature and function to those existing prior to mining. The mitigation measures outlined in the plan include both onsite replacement of features removed within the area disturbed by mining plus creation or enhancement of additional features in an offsite protected area along Mine Creek and Middle Yegua Creek termed the Middle Yegua Mitigation Site. The goal of the offsite mitigation is to restore and enhance an intermittent

Ephemeral and intermittent stream channels exhibiting ordinary high water marks (thus, meeting the primary criteria as waters of the U.S.) within the proposed mine disturbance area have been evaluated and characterized as low, medium, or high quality. Low-quality streams are defined as ephemeral streams that traverse open pastureland and have minimal hydrophytic vegetation or are highly eroded. Medium-quality streams are defined as ephemeral or intermittent streams that have a narrow, relatively undisturbed corridor of riparian woodland, native herbaceous, or hydrophytic vegetation and that are somewhat stable. Ephemeral or intermittent streams that have a broad, mature riparian corridor vegetated by desirable woodlands are characterized as high quality.

Low-quality ephemeral streams would be mitigated at a minimum ~~replacement~~ ***mitigation*** ratio of 1:1 (based on ***both the length and*** the area of affected stream channel). Medium-quality streams would be mitigated at a minimum ratio of 1.5:1. High-quality streams and herbaceous wetlands would be replaced at a minimum ratio of 2:1. On-channel ponds (qualifying as waters of the U.S.) would be reclaimed at a minimum ratio of 1.5:1. Based on these mitigation ratios, the expected disturbance area ***(lengths)*** and associated reclaimed area ***(lengths)*** of various types of waters of the U.S. are summarized in ~~**Table 3.2-9**~~ ***Table 2-14 of the Final EIS***.

~~**Table 3.2-9**~~
~~**Surface Water Features Disturbed, Altered, or Displaced**~~

~~**Waters of the U.S.**~~	~~**Disturbance Area**~~		~~**Mitigation Ratio**~~	~~**Post-reclamation Area**~~	
	~~**(linear feet)**~~	~~**(acres)**~~		~~**(linear feet)**~~	~~**(acres)**~~
~~Stream Low-Quality~~	~~51,511~~	~~6.7~~	~~1:1~~	~~51,511~~	~~6.7~~
~~Stream Medium-Quality~~	~~123,537~~	~~13.3~~	~~1.5:1~~	~~123,537~~	~~20.0~~
~~Stream High Quality~~	~~23,370~~	~~3.6~~	~~2:1~~	~~23,370~~	~~7.2~~
~~**Stream Subtotal**~~		~~**23.6**~~			~~**33.9**~~
~~Ponds~~		~~38.5~~	~~1.5:1~~		~~57.8~~
~~Wetlands~~		~~5.3~~	~~2:1~~		~~10.6~~
~~**Total Waters of the U.S.**~~		~~**67.4**~~			~~**102.3**~~

~~Source: Alcoa 2002d.~~

~~As shown in the table, the total proposed mitigation acreage for direct impacts is 102.3 acres composed of 33.9 acres of stream channel, 57.8 acres of on-channel ponds, and 10.6 acres of herbaceous wetlands or suitable equivalent mitigation as described on Alcoa's draft Mitigation Plan (see Appendix E). A minimum of 23.6 acres of streams and 5.3 acres of herbaceous wetlands would be restored within the mine reclamation area (1:1 replacement of affected resources).~~ ***explained in detail in the Mitigation Plan (see Appendix E of the Final EIS), the affected waters of the U.S. generally would be replaced within the mine area during reclamation.*** Additional mitigation for stream and wetland disturbances would occur at the offsite Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site***. As an excess of the required acreage of ponds would be created within the mine reclamation area, no additional pond mitigation would be required offsite.

~~The remaining 10.3 acres of streams and 5.3 acres of herbaceous wetlands~~ ***A portion of the stream and wetland mitigation*** required to meet the approved mitigation ratios would be accomplished in the offsite Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site*** by the enhancement of ~~an~~ existing riparian corridor***s*** and the creation of wetlands. Mitigation for temporal impacts also would occur in ***these offsite areas where mitigation would commence concurrent with initial mining operations.***~~the Middle Yegua~~

~~Mitigation Site. This proposed mitigation, at a ratio of 0.5:1, would include 11.8 acres for stream channels and 2.7 acres for wetlands. Thus, the total required mitigation in this site would be 22.1 acres for streams and 8.0 acres for wetlands. Because the offsite stream channel mitigation in the Middle Yegua Mitigation Site is proposed as enhancement in an existing stream corridor, the acreage would be doubled to 44.2 acres. Since the wetland mitigation would occur through creation of new wetlands rather than enhancement of existing areas, no doubling would be required. In summary, the proposed mitigation of affected waters of the U.S. would include restoration of at least 23.6 acres of stream channel, 5.3 acres of wetlands, and 57.8 acres of on-channel ponds within the reclaimed mine area plus creation of 8.0 acres of new wetland and 44.2 acres of stream channel/riparian enhancement in the Middle Yegua Mitigation Site.~~ ***Details of the proposed mitigation are presented in Alcoa's Mitigation Plan (see Appendix E of the Final EIS).***

The proposed surface water control system is described in Section 2.5, Proposed Action. With this system, approximately 30 acres of pond water surface would be present during operations in the mining area as a result of normal operating levels in sediment ponds SP-1 through SP-6. Additional water surfaces would be restored in phases via construction of the reclamation ponds (RPC and RPL ponds) during concurrent and final reclamation. Smaller ponds ultimately would be restored in a distributed manner within the mining area. In addition, two end lakes totaling approximately 722 acres would be created on the post-mining surface.

Typically, there would be a 20- to 30-month delay between the removal of a stock pond and reclamation of the area where it was located. Since disturbance and reclamation both would proceed in phases over the area to be mined, a temporal impact would occur as the pit and backfill progress. In addition, the geographic distribution of large numbers of scattered stock ponds and small depressions would change. Additional surface water acreage would be developed in the proposed end lakes. Once the end lakes are in place and filled, the total acreage of newly impounded surface water in the permit area would be approximately 895 acres.

The phased installation of diversion structures during operations would offset some of the potential impacts associated with the removal of waters of the U.S. and upland drainage features. The proposed post-mining topography and the position of many of the proposed reclamation ponds are shown in **Figure 2-14**, Post-mine Land Uses. Temporary impacts to drainageways (ephemeral and intermittent stream channels) would occur as the original system is removed and sequentially replaced by the post-mining configuration.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, potentially would eliminate mine-related disturbance in a minor portion of the upper reach of one tributary to Willow Creek and portions of two tributaries to Chocolate Creek. Also, this modification potentially could result in additional disturbance to the upper reaches of one of the tributaries to Chocolate Creek, depending on where the southeastern boundary of the mine area would be extended to offset the exclusion areas. Alcoa would evaluate the potential effects to this tributary. If the additional disturbance would result in adverse effects to waters of the U.S., Alcoa would submit a request to modify any Section 404 permit that may be in place at the time of the request for review by the USACE. Pending the outcome of such a review, the USACE may decide to issue the permit modification, issue the permit modification with conditions, or deny the permit modification. Should the USACE decide to issue the permit modification with special conditions, additional compensatory mitigation may be required. Such additional mitigation

requirements likely would be calculated in accordance with the applicable mitigation ratios identified in Table 3.2-9 of the Draft EIS. It is assumed that the mine-related impacts to existing stock ponds and springs would be similar to the impacts described in Section 3.2.4.2 of the Draft EIS.

Effects from Watershed Modifications. ***Impacts on streamflows would occur as a result of implementing the surface water control system and from modifying drainage patterns and contributing watershed areas. These long-term impacts would occur as a result of surface water management programs during the active phase of mining and from reclamation activities during and after mining.*** ~~The reach of Middle Yegua Creek in the vicinity of the proposed permit area has been tentatively classified by TNRCC as intermittent with perennial pools. All other tributaries within the proposed permit area have been classified by TNRCC as intermittent with no perennial pools.~~

Baseline investigations indicate that ephemeral or intermittent conditions ***generally*** exist on the areas that would be disturbed. ***Short perennial reaches also have been identified through these site-specific inventories. The perennial reaches are indicated in Figure 3.2-21 of the Draft EIS, and occur along Big Sandy and Little Sandy Creeks outside the proposed permit area, and along Middle Yegua Creek. Perennial reaches would not be disturbed by mining. The proposed haul road crossing of Middle Yegua Creek has been designed to minimize adverse impacts to the stream.*** Proposed mining activities and construction of surface water control systems may affect both flow rates and runoff volumes of downstream waterways. These control systems are described in Section 2.5. Alcoa has conducted hydrologic and hydraulic modeling for selected streams in and adjacent to the permit area in order to compare baseline conditions to active mining conditions (Alcoa 2000 [Volume 5]). On lower Mine Creek, flow in the channel immediately downstream of sediment pond SP-1 would reach a simulated peak stage of 439.8 feet and a peak velocity of 3.1 feet per second when modeling the 10-year, 24-hour event under existing conditions. Under the condition of active mining, the simulated peak stage was reduced to 436.4***8*** feet, and the peak velocity was reduced to 1.~~7~~***6*** feet per second. In addition, the simulated peak runoff was reduced from approximately 8,000 cfs to approximately ~~4,000~~***7,600*** cfs. The total simulated runoff volume on Lower Mine Creek was reduced from approximately ~~3,000~~***2,970*** acre-feet under existing conditions to approximately ~~1,600~~***1,440*** acre-feet under the active mining scenario (~~Alcoa 2000 [Volume 10]~~***Alcoa 2001b [Volume 6])***).

Similar analyses were conducted for Big Sandy Creek at U.S. Highway 290 (station LBS) and Middle Yegua Creek just downstream of the proposed permit area (station LMY) (**Figure 3.2-21**) (Alcoa 2001b [Volume 5]). When compared to baseline conditions modeled at these stations, the results indicate ~~substantial~~ ***negligible*** decreases in peak flows for both creeks under active mining conditions over the life of the mine. Total runoff volumes modeled for the selected storms (10-year through 100-year, 24-hour events) are projected to increase slightly for Big Sandy Creek at station LBS, and negligible changes are predicted for Middle Yegua Creek at station LMY during the active mining phase.

Peak flows ***in the area downstream of the mine*** are projected to decrease ***slightly*** during mining as a result of the proposed surface water control system ~~for surface water resources~~, since the sediment ponds would ~~reduce flooding and the erosion potential of the channels and banks~~***detain runoff from large rainfall events***. In addition, releases from pond storage would sustain flows for a somewhat greater length of time after a runoff event. The modeling results projected that these effects on peak runoff would be similar for the Mine Creek, Big Sandy Creek, and Middle Yegua Creek drainages during the active mining phase. The modeling has shown there would be a ~~substantial~~ ***slight*** reduction in runoff volume in Mine Creek**,** ~~but not in~~ Big Sandy ***Creek, and*** ~~or~~ Middle Yegua Creek~~s~~. These effects would be less for the larger basins, due to their relatively smaller areas of disturbance. No effects from mining disturbance would occur in the Brushy Creek drainage.

Whenever drainage modifications and hydrologic changes occur in a watershed, it is possible that flooding may be increased downstream. The proposed Three Oaks Mine would create watershed changes and modify hydrologic conditions as a result of implementing the surface water control system and releasing discharges of storm water and groundwater. In general, the 100-year, 24-hour peak flow rates for Big Sandy Creek, Chocolate Creek, Middle Yegua Creek, and their associated tributaries would be decreased downstream of the mine as described previously. The duration of runoff discharge from storm events would be increased slightly due to the routing effects of proposed ditches, sediment ponds, and detention ponds (see Section 2.5.1.1 of the Draft EIS). In summary, the maximum flow rates from storms would remain the same as before mining or would be decreased slightly, but the length of time that storm discharges occurred would be somewhat greater due to attenuation of the flood peak.

The Federal Emergency Management Agency (FEMA) has regulatory authority for floodplain management issues as promulgated in 44 CFR under the National Flood Insurance Reform Act of 1994. Texas is within FEMA Region VI, which is headquartered in Denton, Texas. Each of the counties in the project region also is empowered, through FEMA and its system of county floodplain administrators, to investigate and manage floodplain development, land uses and habitat values, and flooding issues on a county-wide basis. Established FEMA county floodplain management programs exist in Bastrop and Lee Counties, which cover the proposed permit area and nearby downstream drainages. Technical and administrative personnel at FEMA Region VI and in both Bastrop and Lee Counties have been contacted and informed of the Proposed Action (Burrell 2002a,b,c).

In addition to its regulatory role, FEMA identifies and delineates floodprone areas. FEMA maps for Bastrop County indicate that flood zones occur along Chocolate Creek, its unnamed tributary immediately to the south, and Big Sandy Creek (FEMA 1991). Maps for Lee County indicate flood

zones along Middle Yegua Creek (FEMA 1982). These delineations indicate that Zone A special flood hazard areas, which would be inundated by the 100-year flood, occur along these creeks. Zone A delineations are those where base flood elevations have not been determined (i.e., the predicted or historical water level from the base flood has not been identified). In such areas, the base flood used for hydrologic or hydraulic analysis is the 100-year flood (44 CFR Part 65.6[a][9]).

To further investigate potential flooding impacts from the Proposed Action, Alcoa conducted land surveys of stream channels and adjacent floodplain areas (overbanks) along the creeks identified above (Harden 2002d). Geometric data for the drainages consisted of interconnected networks of cross-sections perpendicular to the channels and overbanks. Approximately 450 cross-sections were created in the Big Sandy network, which extended along Chocolate Creek and its unnamed tributary from below the mine to the Big Sandy confluence, several miles of Big Sandy Creek extending from above Outfall 002 (see Figure 2-9 of the Draft EIS) to the Old McDade Road, and approximately 1 mile of Little Sandy Creek above its confluence with Big Sandy Creek. The cross-sections were created using USGS topographic maps. Approximately 93 cross-sections were surveyed along Middle Yegua Creek in a reach extending upstream and downstream from the proposed haul road crossing.

Hydrologic data for the areas of concern consisted of predicted 100-year, 24-hour peak discharges from storm precipitation. These values were determined using the USACE HEC-1 Flood Hydrograph model, with a standard practice approach to defining inputs (Harden 2002d). The resulting peak flows for the creeks of concern and their segments (reaches) are shown in Table 3.2-9a. Reaches were defined where flows or other hydraulic conditions change (e.g., at confluences).

Table 3.2-9a
Peak Flow Modifications due to the Proposed Action

Stream	Reach	Approximate Pre-mine 100-year, 24-hour Peak Discharges (cfs)	Approximate Active and Post-mine 100-year, 24-hour Peak Discharges (cfs)
Little Sandy Creek	1	13,627	13,627
Big Sandy Creek	1	1,793	1,793
Big Sandy Creek[1]	1	5,491	3,745
Big Sandy Creek	2	15,762	15,478
Big Sandy Creek	3	18,140	17,794
Unnamed Tributary to Chocolate Creek	1	9,628	9,453
Chocolate Creek	1	2,503	2,503
Chocolate Creek	2	11,345	11,175
Middle Yegua Creek at Station LMY	1	37,752	35,362 (active) 27,382 (post-mining)

[1]*Additional tributaries enter this reach of Big Sandy Creek; however, for purposes of the model topology, it has the same reach number.*

Resulting data from the geometric surveys and hydrologic modeling then were used as input to the USACE HEC-RAS (River Analysis System) hydraulic model to predict flow conditions under the

100-year, 24-hour flood event before, during, and after mining. On all of the stream segments in the Big Sandy drainages, negligible changes occurred between the predicted pre-mining, active, and post-mining hydraulic conditions for the 100-year, 24-hour floods. Predicted water surface elevations at the cross-sections were within 0.10 foot between the scenarios, and flow velocities were essentially unchanged. Slight decreases in water surface elevations and velocities were typically predicted when comparing the active or post-mining conditions to the pre-mining conditions. No flooding or erosion impacts from the FEMA base floods in the Big Sandy or Middle Yegua drainages are predicted from the Proposed Action.

As discussed in a later section (Effects of Discharges to Streams), Alcoa proposes to release depressurization water at Outfalls 001 and 003 (see Figure 2-9 of the Draft EIS). Currently these discharges are estimated to range from approximately 2 to 7 cfs at Outfall 001 and approximately 3 to 9 cfs at Outfall 003. These rates are dependent on the phase of mining, drainage routing, and depressurization need. Because the base flood (100-year event) is large and rare, further investigation into the potential effects of these mine discharges on the more common (2-year) event was conducted for the drainage systems. Based on HEC-1 modeling predictions, the estimated 2-year, 24-hour peak flows in the drainages are:

- *CC (lower Chocolate Creek) = 2,112 cfs*
- *LBS (lower Big Sandy Creek) = 6,469 cfs*
- *LMY (lower Middle Yegua Creek) = 7,455 cfs*

The expected depressurization discharges are quite small in comparison to these peak storm runoff estimates. No flooding or erosion impacts from the additional mine discharges are anticipated during the more frequent 2-year, 24-hour storms.

The creek channels along the Big Sandy drainage are small and have limited conveyance capacity; flows tend to back up along the creeks and into tributaries. Because homes, a school, and private property improvements occur in or near the FEMA Zone A delineations along this channel system, further impact assessment was conducted with respect to potential effects from depressurization discharges. Since depressurization discharges are likely to occur over extended periods of time, the possibility exists for filling the channels and inundating small areas in the adjacent overbanks. This potential was investigated using the surveyed cross-sectional data from the HEC-RAS modeling, with discharge inputs based on the likely range of depressurization discharges into Chocolate Creek (3 and 9 cfs).

At the confluence of Big Sandy Creek and Chocolate Creek (see Figure 2-9 of the Draft EIS), the flows from Outfall 003 are predicted to fill Chocolate Creek to depths ranging from approximately 1.3 to 1.7 feet above the lowest point in the channel. Flows are predicted to stay in the channels at the confluence and downstream. Upstream on Chocolate Creek, at the confluence with its unnamed southern tributary (see Figure 2-9 of the Draft EIS), flows would fill the channel section to depths ranging from approximately 0.6 to 0.9 feet above the lowest point in the channel. Farther upstream on Chocolate Creek, above its large bend, discharges are predicted to fill the channel to depths ranging from approximately 0.2 to 0.5 feet above the lowest point in the channel. These differences, which may seem somewhat counter-intuitive, are due to rising and falling changes in the lowest bed

elevations between different channel sections. Flow velocities are substantially less than 2 feet per second except at two or three narrow, constricted sections. At these locations, some additional downcutting or channel widening may occur until equilibrium is reached and the channel becomes stable. The extent of such changes would be minimal, due to the relatively few areas where natural flow constrictions occur, and the fact that existing channel-forming flows are much larger than anticipated depressurization flows.

Depressurization flows generally would stay within the channel sections. At the confluence of Chocolate Creek and Big Sandy Creek, flows in Chocolate Creek would range from approximately 10 to 30 feet wide, narrowing to approximately 20 feet wide in Big Sandy Creek. Upstream above the large bend in Chocolate Creek, flows may occupy divided channels. Flow depths and widths all along Chocolate Creek would vary to correspond with the existing channel geometry. There may be areas adjacent to the low-flow channel that become inundated to shallow depths from the mine discharges. Such conditions may occupy the overall channel section formed by larger natural channel-forming flows. Flow velocities would be quite small in these areas, becoming essentially ponded during the duration of discharge. More extensive flooding or related impacts are not anticipated from depressurization discharges.

Existing low-water crossings of Chocolate Creek and its unnamed tributary would be structurally mitigated by Alcoa in compliance with RRC permit requirements. Based on this requirement and its inclusion in the Proposed Action, only minor impacts to low-water crossings and related access are anticipated.

Following mine closure and final reclamation, drainage from approximately 9,800 acres would be routed through detention ponds and end lakes. Detention of runoff in these structures would result in fewer and smaller flows into the downstream drainages. ***Post-mining peak flows at stations LMY and LBS are predicted to noticeably decrease (Alcoa 2001b [Volume 5]).*** The end lakes would be constructed with spillways designed to pass flows during larger runoff events (Harden 2002a). These features would allow discharge to the downstream channels when the lakes overflow their outlets. This condition would be most likely to occur when the lakes are filled to capacity and storms occur during the winter and spring, when evaporation is at a minimum and precipitation amounts are maximum. During smaller events and during other seasons of the year, runoff that would have provided minor flows in downstream channels likely would be captured in the end lakes and evaporated. This would reduce flows in the immediate downstream portions of ephemeral channels such as Chocolate Creek, Willow Creek, and the unnamed eastern tributary of Willow Creek. The actual amount of reduction would depend on the reclaimed surface characteristics. Based on the amount of watershed controlled by end lakes or permanent ponds, it is reasonable to expect a slight post-mining reduction in mean annual yield for these smaller headwater tributaries. Flow in these tributaries is usually small (less than 1 cfs) and is quickly lost to seepage and evapotranspiration. The flow typically ceases during dry periods, particularly in the late spring, summer, and fall.

Following mining and reclamation, the overall flows in Chocolate Creek, lower Willow Creek, and parts of Mine Creek would incorporate the rate and timing of discharges from the end lakes and permanent ponds (see **Figures 3.2-21** and **2-14**). Runoff from adjacent undisturbed watershed areas also would contribute to ephemeral flows in these channels, as under existing conditions. Preliminary modeling of end lake discharges has been conducted to improve the understanding of their surface water flow regime

Because of their substantial size and depths, the end lakes would not be similar to any of the other surface water features in either the existing landscape or the reclamation area following mining. They also are expected to have greater effects on watershed dynamics than would the smaller ponds.

The design of the end lakes would focus on creating deep, elongated configurations with shallow slopes at the margins. Fluctuation of the end lake levels would occur as a result of evaporation and rainfall/runoff contributions. Based on preliminary design, it is anticipated that the levels typically would vary over a range of 2 to 4 feet. Construction of the sloping shorelines would need to accommodate this variation and provide an additional margin for habitat and safety at shallower lake levels. As a result, additional mitigation may be appropriate (see mitigation measure SW-1 in Section 3.2.4.4, Monitoring and Mitigation Measures).

The proposed end lakes were investigated with the RESOP model using approximately 26 years of representative historical hydrologic and meteologic data. The historical period used for model inputs incorporated average, drought, and wet hydrologic conditions (see **Figure 2-14**). Results of the preliminary RESOP modeling are shown in **Table 3.2-10**.

Table 3.2-10
End Lake Modeling Summary

End Lake	Number of Months per Year in which Discharges would Occur (Range)	Number of Months per Year in which Discharges would Occur (Average)	Discharge Volumes in Months when Flows Occur (Range in acre-feet)	Discharge Volume in Months when Flows Occur (Average in acre-feet)
South	0 to 4	1.2	0 to 1163	281
North	0 to 6	2.0	0 to 2048	927

Source: Harden 2002b.

The results indicate that the end lakes would discharge in a manner that approximates the occurrence of larger runoff events~~ and to some degree lower prior evaporative losses~~. ***However, when such a larger event is preceded by prolonged periods of low precipitation and high evaporative losses, end lake discharges may become diminished or cease entirely.*** Discharges to the ephemeral channels therefore would approximate the rainfall-driven, sporadic flow conditions typical in these channels in their undisturbed state for larger precipitation events. For example, instantaneous baseline data in **Table C-9** (see Appendix C) can be used to examine general flow conditions for representative ephemeral tributaries in the vicinity. Although the data are for a shorter period than was used for the RESOP modeling, they indicate that for the ~~24~~ ***40*** months of instantaneous baseline data presented, ***measurable*** flows occurred in ~~5~~ ***10*** months at Station UWC ***(Upper Willow Creek)***, in ~~5~~***11*** months at Station LWC ***(Lower Willow Creek)***, and in ~~5~~ ***8*** months at Station CC ***(Chocolate Creek)***. ***These are the monitoring stations that represent the comparable post-mining channels. Measurable flows occurred zero to four times a year at Station CC, zero to five times a year at Station LWC, and one to five times a year at Station UWC. Even in wetter years of the inventory, all of these flows were small. At Station CC, the maximum baseline flow was 0.44 cfs (26 acre-feet/month). At Station LWC, the maximum flow was 1.67 cfs (103 acre-feet/month), and most measured flows were about one-tenth that rate. At Station UWC, the maximum baseline flow was 1.5 cfs (92 acre-feet/month), and most flows were much smaller.*** Substantial periods of zero flow conditions also occurred at these stations.

Changes to the ephemeral flow conditions and watershed yield immediately downstream of the proposed end lakes would constitute surface water resource impacts. Immediately downstream of the proposed end lakes, the anticipated flow changes could result in altered sediment deposition and scour patterns in the stream channels. ***This is most probable in the reclaimed configuration where the proposed South End Lake would divert the Chocolate Creek watershed into the smaller unnamed drainage to the south. Because the unnamed drainage is currently adapted to a smaller watershed yield, additional long-term channel instability and flooding could occur along the unnamed tributary downstream of the permit area.*** As a result, monitoring and mitigation may be appropriate (see mitigation measure SW-2 in Section 3.2.4.4, Monitoring and Mitigation Measures). ***As discussed below, t***~~T~~he degree and extent of such localized impacts would be alleviated by undisturbed downstream conditions that dominate the overall flow regime. In addition, restoration of riparian corridors and stream channels would take place during reclamation. No long-term effects on channel geometry are anticipated ~~farther downstream, assuming~~ ***on the larger streams (Big Sandy and Middle Yegua Creeks), given*** that large flows still would occur frequently under periodic conditions of larger rainfall events and higher lake levels.

Mining disturbance would comprise comparatively smaller proportions of the watersheds at the Lower Big Sandy and Middle Yegua Creek monitoring stations (LBS and LMY, respectively, **Figure 3.2-21**). After mining and reclamation, the area upstream of Big Sandy Creek at baseline gaging station LBS would be modified by the end lakes controlling runoff from 6.4 square miles in the Chocolate Creek tributary drainage. This area represents approximately 16 percent of the baseline watershed at station LBS. For baseline gaging station LMY on Middle Yegua Creek, the area contributing under most runoff conditions would be modified by approximately 8.9 square miles in the upper Willow Creek tributary being controlled by the end lakes. This comprises approximately 16 percent of the baseline area at station LMY. Runoff from these areas would terminate in the end lakes or permanent ponds under drier conditions. When the lakes are full and large rainfall-runoff events occur, spillways at the lakes and permanent ponds would allow continuation of flow downstream. This most likely would happen during the winter and spring during larger precipitation events. Hydrologic modeling of severe storms for the downstream stations LBS and LMY indicates that under post-mining conditions there would be substantial decreases in peak flow rates; however, total runoff volumes would remain essentially unchanged for the 10-year through 100-year storm events. This is consistent with the revised drainage patterns and flow routing conditions. These modifications to peak flows for larger events would constitute an impact to water resources.

Stream channel studies completed by Alcoa in the Sandow area indicate that minor sedimentation has occurred there for relatively short distances downstream of mine discharge outfalls. Inspection of data and photographs taken from a large number of sites bordering the Sandow Mine indicates that these effects are limited to short stream reaches immediately adjacent to the major outfalls.

This minor sedimentation likely is due to reductions in channel-forming discharges resulting from watershed changes and attenuation of peak flows by the mine water control system (Horizon Environmental Services, Inc. 2002). This has resulted in minor aggradation, which rapidly diminishes with distance downstream of the mine. Elsewhere upstream and downstream of the Sandow Mine, existing land uses and surface geology dominate the stream channel conditions. There is no evidence of accelerated channel or bank erosion due to mine water management in the Sandow area.

Similar conditions are likely to occur at the proposed Three Oaks Mine. During active mining, the contributing watershed areas at Outfalls 001 and 003 would remain more or less the same. Minor sedimentation may occur there as a result of flow peak attenuation. At Outfall 002, the increased contributing area may create minor channel erosion. If this occurred, it would be mitigated in accordance with RRC regulations and permit compliance. Small drainages near Outfall 002 may aggrade toward more of an upland swale condition, as their contributing areas are drained toward the outfall. None of these changes would create substantial impacts outside the permit area.

In the post-mining drainage condition, negligible changes to upper Big Sandy Creek would occur below Outfall 002. Erosion or sedimentation may occur downstream of the end lakes due to reconfigured drainage conditions. Depending on the location along a stream reach and the frequency of end lake outflows, cycles of erosion and sedimentation may occur. Any such effects gradually would diminish downstream of the end lake outlets, due to the effects of larger watershed areas and incoming stream tributaries. However, because of potential impacts on stream channel conditions downstream of the proposed mine, additional mitigation has been recommended.

According to estimates of post-mining conditions, approximately 1,724 acre-feet per year are anticipated to be evaporated from the two end lakes (Alcoa 2001b [Volume 5]). Assuming this amount is evenly divided between the two lakes, approximately 862 acre-feet per year would be lost from the Big Sandy drainage (south end lake) and the same from the Middle Yegua drainage (north end lake). If regional average annual surface water yields (based on the USGS gages near McDade and Dime Box) are representative of the project area watersheds, this value represents approximately 12 percent of the mean annual yield for the Big Sandy watershed at baseline monitoring station LBS. Similarly, the lake evaporation would represent approximately 9 percent of the mean annual yield for the Middle Yegua watershed at baseline monitoring station LMY. (It is assumed that evapotranspiration and other factors affecting flows already are incorporated into historical gaging records.)

Flows from the remaining undisturbed portions of the Big Sandy watershed, from Mine Creek, and from the undisturbed portions of the Middle Yegua watershed would continue to pass downstream. No effects from mining or reclamation would occur in the Brushy Creek drainage. The main branches of Little Sandy and Big Sandy Creeks lie outside of the permit area and would not be directly disturbed. The intermittent nature of Big Sandy Creek would continue; however, low-to-average flow rates and their durations near the mine

accordance with previous modeling procedures for the mine permit application. The results, which are useful for comparative purposes, are shown in **Table 3.2-11**.

Table 3.2-11
Runoff Volume Comparisons at Station LMY
(acre-feet)

Rainfall Event (inches)	0.75	1.5	2.0	4.0
Conditions/Runoff Situation	**Runoff Volume (acre-feet)**			
Antecedent moisture condition 1+0.6[1]				
Total runoff at LMY without contributions from north end lake	0.0	41.8	245.4	2214.2
Total runoff at LMY with contributions from north end lake	0.0	78.4	359.4	2891.9
Antecedent moisture condition approximately 2.5[1]				
Total runoff at LMY without contributions from north end lake	49.6	666.4	1324.0	4866.5
Total runoff at LMY with contributions from north end lake	78.7	880.9	1713.6	6129.4

[1]Antecedent moisture condition refers to the condition in the watershed prior to the rainfall, with lower values indicating drier conditions of the soil and surface. The value 1+0.6 is often used for hydrologic modeling in Texas. A value of 2.5 indicates that conditions in the watershed are comparatively wet when rainfall occurs.

Source: RWHA 2002c.

Rainfall does not always produce runoff if moisture conditions on the land are not conducive. It can be seen in the table that under drier antecedent conditions, a rainfall of 0.75 inch does not produce runoff at LMY, even though a large part (approximately 60 percent) of the watershed would remain undisturbed and uncontrolled. ***As shown in the table, the proposed end lakes would not affect this outcome under these drier conditions.*** The differences with wetter antecedent conditions can be seen in the lower part of the table. Under either condition, the greater impermeable area contributed by the end lakes would increase the total runoff volume when they do contribute flows. However, as noted previously, the end lakes also would reduce peak flow rates due to routing effects.

Flow changes would create little or minimal effects on any perennial pools that occur along Middle Yegua Creek near the mine. If there is sufficient rainfall in the region to produce runoff at LMY, the total volume of any perennial pools that may occur in Middle Yegua Creek in the vicinity is likely to be much less than the runoff volumes shown in **Table 3.2-11**. Similar conditions would apply to Big Sandy Creek, as discussed previously.

Additional contributing watersheds join Middle Yegua Creek shortly downstream of station LMY, and the effects on flow from end lake control would diminish downstream of that point. At the Middle Yegua USGS gage near Dime Box, the drainage area is approximately 236 square miles. The subarea draining to the north end lake and to permanent ponds RPC-1 and SP-1 on the reclaimed site represents approximately 3.8 percent of that watershed. The area controlled by Somerville Lake is approximately 1,003 square miles, and the watersheds draining to reclaimed area impoundments represent approximately 0.9 percent of that area. No effects from mining disturbance or reclamation would occur on Brushy Creek. Negligible effects are anticipated to Somerville Lake and to the Brazos River downstream. Somerville Lake evaporation losses are estimated at approximately 19,000 acre-feet per year at normal pool extent, and approximately

Effects from Road and Bridge Improvements. Approximately 20 culverts would be placed under the proposed Three Oaks-to-Sandow haul road during its construction (Alcoa 2001b [Volume 6]). The SEDCAD computer model was used to determine the peak flows for each culvert, using the 10-year, 6-hour event. The culverts themselves were designed using the Texas Hydraulic System Culvert Design computer model. Each of the culvert structures would have a riprap lined channel section at the outlet to prevent channel erosion. Culverts having flow velocities greater than 9 feet per second would have grouted outlets followed by a riprap section downstream. Haul road ditches also were designed in accordance with standard practice, and are proposed to have a bottom width of 10 feet with sideslopes of 4 horizontal:1 vertical. Grass or rock lining would be utilized at appropriate locations in accordance with hydraulic modeling to minimize scouring.

A bridge crossing of Middle Yegua Creek also is proposed, and the hydraulics of the design have been analyzed. The proposed bridge crossing of Middle Yegua Creek is the only crossing that would potentially be subject to TNRCC regulatory review and approval. All other proposed crossings would consist of culverts on ephemeral stream channels. Review of floodplain maps issued by the Federal Emergency Management Agency (FEMA) indicate that the proposed Middle Yegua Creek crossing is the only proposed crossing that would cross through a Zone A 100-year floodplain (FEMA 1982). A Zone A determination is based on approximate methods rather than detailed hydraulic analysis. TNRCC has reviewed the design and determined that the bridge would not significantly control, regulate, or otherwise change the floodwaters of Middle Yegua Creek and, therefore, does not fall under TNRCC's jurisdiction (Alcoa 2001b [Volume 6]).

All stream crossings would be constructed in a manner to minimize impacts to streams. The proposed bridge and culverts would be sized to adequately carry the flow and minimize disturbances upstream or downstream from the proposed crossings. The proposed bridge over Middle Yegua Creek is the only crossing that would require substantial upstream or downstream channel modification. All non-rocked surfaces of the crossing would be promptly revegetated to minimize erosion and sedimentation. Silt fences and other BMPs would be utilized during and after construction to control erosion and promote revegetation.

As the construction of culverts and the proposed bridge may generate changes to the channel cross-sections and promote ongoing bed and bank changes (scour, bank caving, and sedimentation), potential impacts to stream channels may occur. The potential for such ***short-term*** impacts may be reduced by the proposed control practices. However, additional mitigation of such impacts may be appropriate (see mitigation measure SW-3 in Section 3.2.4.4, Monitoring and Mitigation Measures).

Effects to Surface Water Resources from Water Level Changes. The majority of stream flow in the study area originates from precipitation events. However, small flows from groundwater contribution (baseflows) appear to exist for some of the stream segments, specifically for the intermittent streams, in the study area. These gaining reaches, along with known seep and spring locations, are associated with the outcrop areas of the Simsboro and Carrizo aquifers, as shown in **Figure 3.2-22**. Depressurization and dewatering pumping in the Simsboro and Calvert Bluff aquifers, respectively, is not projected to affect the Carrizo aquifer, as discussed in Section 3.2.3.2 under Impacts to Groundwater Levels. As a result, gaining reaches and spring and seep flows originating from the Carrizo aquifer outcrop would not be affected by the Proposed Action.

Gaining reaches of streams were determined through analysis of field data and measured groundwater levels. Field data were collected by RWHA (Alcoa 2000 [Volume 5]) between December 1999 and August 2000 for streams within the study area that had existing flow. Due to dry and low precipitation conditions, it was assumed that these flowing reaches were fed by groundwater. For the EIS analysis, the field data were extrapolated through data review of the depth to water measurements for wells completed in outcrop areas of the Simsboro and Carrizo aquifers. To provide a conservative approximation for this EIS analysis, additional gaining reaches have been assumed to exist within an approximately 1-mile radius of monitoring wells that indicated a depth to water of 10 feet or less. The actual length of gaining reaches could vary between this radius and a much smaller distance (e.g., 100 yards or less), depending on the geologic setting of the channel and evapotranspiration demands. Flow gains and losses in the area channels also are likely to vary substantially with seasons and with wet or dry climatic cycles.

Potentially gaining reaches in the study area include downstream reaches of Little Sandy Creek and Burlson Creek near the confluence with Big Sandy Creek; upstream and western tributaries to Big Sandy Creek, as well as reaches near Big Sandy Creek's confluence with the Colorado River; and upstream tributaries to Middle Yegua Creek. No gaining streams have been identified in association with the Calvert Bluff aquifer, due to the low permeability of the clay units and resulting confinement of available groundwater primarily to the sand lenses within the Calvert Bluff Formation, as described in Section 3.2.3.2 under Impacts to Groundwater Levels, Calvert Bluff Aquifer Dewatering.

Natural baseflows in ~~the~~ ***most of the baseline*** study area are commonly small (approximately 0.5 cfs or less seasonally for Simsboro outcrop baseflows), and during the summer months seepage into the channels is typically taken up by evapotranspiration over comparatively short reaches, particularly under drought conditions (Alcoa 2001b [Volume 5]). Review of data collected during the baseline surface water inventory suggests that recent baseflow contributions typically have been within that range on Little Sandy Creek (station LLS) immediately west of the permit area. In contrast, baseflows in the uppermost reaches of Big Sandy Creek (station UBS) are much smaller (approximately 0.02 to 0.1 cfs). ***Farther downstream on Big Sandy Creek, a review of USGS gaging data indicates that baseflows range from approximately 0.5 to 1.0 cfs at gaging station 08159165, and range from approximately 0.5 to 1.5 cfs at station 08159170 (see Figure 3.2-1 of the Draft EIS). The former station has a watershed area of approximately 39 square miles, and the latter has a watershed area of approximately 64 square miles.*** This illustrates the wide variation in baseflow magnitudes across even a relatively small area.

Both stations LLS and UBS, were identified by RWHA (Alcoa 2001b [Volume 5]) as being within a part of the study area that exhibits baseflow contributions. In addition, these stations exhibited a more consistent occurrence of flow than other stations in the vicinity. Zero-flow conditions were common along Lower Mine Creek at station LMC, for example. This station has a watershed similar in size to that of Little Sandy Creek at station LLS, which had nearly continuous flow. As with Mine Creek, other creeks having negligible baseflow contribution include Chocolate Creek and Willow Creek. These results are indicated in **Figure 3.2-21**.

Flow losses, as indicated by decreases in average flow per square mile, occur along Big Sandy Creek between its confluence with Little Sandy Creek west of the permit area and the next downstream gage at station LBS. By a similar comparison, additional decreases occur between station LBS (USGS

the permit area vicinity, and that such contributions are lost to infiltration and evapotranspiration within relatively short distances.

As noted earlier in Section 3.2.4.1, Middle Yegua Creek within the permit area has been tentatively classified by TNRCC as intermittent with perennial pools. It is assumed from USGS gaging records that this classification applies to Middle Yegua Creek downstream to the study area boundary. All other streams in the permit area have been classified by the TNRCC as intermittent with no perennial pools; however, field observations indicate that most channel reaches are ephemeral. Based on USGS ~~gaging~~ records ***(at gages 08159165, 08159170, and 08109700; see Figure 3.2-1)***, Big Sandy Creek and ~~East~~ ***Middle*** Yegua Creek from the permit area boundary to the study area boundary are intermittent~~ with perennial pools~~. ***Observations made during the surface water baseline inventory indicate that reaches of these streams outside of the permit area are intermittent with pools of varying sizes that are present throughout the year.***

The approximate location of gaining reaches of streams associated with the outcrop of the Simsboro Formation in relation to the modeled drawdown contours within the Simsboro aquifer are shown in **Figure 3.2-24**, based on the assumptions described above. Drawdown within the Simsboro aquifer as a result of depressurization activities may result in decreased flows in the gaining reaches of streams associated with the Simsboro outcrop area, depending on the stream's location within the drawdown cone. In those areas where the groundwater drawdown within the outcrop is projected to be 10 feet or less, it is not anticipated that gaining reaches would experience a measurable decline in groundwater baseflow contribution. Gaining stream segments within the 10- to 20-foot drawdown area may experience a decline in groundwater baseflow contribution, and it is anticipated that the gaining reaches within the 20-foot or greater drawdown area would experience a measurable decline in groundwater baseflow contribution (see **Figure 3.2-24**). ***In some reaches and in some years, groundwater level declines may create losing conditions (surface water seepage losses into the near-surface aquifer zone), whereas prior to the pumping effects, gaining conditions may have occurred.*** The intermittent nature of the major streams in the study area would not be affected by drawdown-induced baseflow reductions; however, the duration of seasonal stream flows and associated temporary or perennial pools that may exist in the major channels may be decreased, depending on the location in relation to the drawdown contours.

The level of impact to gaining reaches of streams in the study area from drawdown in the Simsboro aquifer would vary based on the percentage of total flow currently provided by groundwater baseflow. While data do not exist to accurately determine this contribution, available data demonstrate that total flow in all but one gaining reach associated with the Simsboro outcrop was less than 0.2 cubic feet per second (cfs) at the time of the ~~RWHA~~ ***baseline*** low-flow survey (Alcoa 2000 [Volume 5]). Data from one sample location on Little Sandy Creek showed natural flows of greater than 0.2 cfs, which indicates a larger baseflow contribution during the low-flow measurement program. One sample location on Middle Yegua Creek and one sample location on a tributary to Middle Yegua Creek also showed flows greater than 0.2 cfs; however, it is likely that these flows were due to discharges from the Sandow Mine or the City of Elgin wastewater plant rather than natural baseflow contributions (Alcoa 2001b [Volume 2]). **Table 3.2-12** provides the mean daily flow rate for Middle Yegua and Big Sandy Creeks. In general, the smaller the mean flow rate for a given stream, the greater potential impact baseflow reductions may have on stream flow. However, comparisons must be made cautiously to ensure that the gaged areas and periods of record are the same. Similar data are not available for other potentially gaining reaches identified in the study area.

Table 3.2-12
Mean Daily Stream Flow[1]

Stream Name and Gaging Location	USGS Gaging Station Number	Period of Record	Mean Daily Flow Rate (cfs)
Middle Yegua Creek near Dime Box	08109700	8/62 - 9/00	56.0
Big Sandy Creek near McDade	08159165	8/79 - 9/85	8.8

[1]No data exist for Little Sandy or Burlson Creeks. The flow for these creeks can be assumed to be less than for Big Sandy Creek. Data do not exist for West Yegua Creek.

rainfall during a given time period. Due to the fact that most streamflows in the area rely on precipitation, baseflow reductions in the study area typically would have the greatest impact on surface water quantity in gaining reaches during times of low precipitation.

The potentially gaining reaches most likely to ~~be affected by~~ ***experience long-term impacts as a result of*** groundwater withdrawal from the Simsboro aquifer include the upstream tributaries to Big Sandy Creek, Middle Yegua Creek, and Walleye Creek. On the upper Big Sandy tributaries, a modeled drawdown of 50 to 100 feet in the aquifer would have the greatest impact on groundwater baseflows. Other channel sections on Little Sandy Creek and Big Sandy Creek, specifically those reaches located within the 20- and 50-foot drawdown contours, may have measurable baseflow declines (see **Figure 3.2-24**). On Big Sandy Creek below TPDES Outfall ~~002~~***003***, these effects may be outweighed during mining by releases at the outfall. A short gaining reach upstream of the outfall likely would be affected by baseflow losses during mining, as would a short section of Little Sandy Creek near its confluence with Big Sandy. After mining (and associated TPDES discharges) ceases, the channel sections below the former outfalls likely would experience measurable declines in groundwater baseflow contributions. ~~The actual decreases would be small (probably less than 0.25 cfs) but are difficult to quantify since baseflows vary seasonally, and the stream flow in this vicinity is typically non existent in late summer and early fall.~~ ***The actual decreases would be small but are difficult to quantify since baseflows vary seasonally and annually. Streamflows in this vicinity typically are non-existent in late summer and early fall. Depending on location, baseflows appear to be generally less than 0.5 cfs and are likely to be less than 1.0 cfs even after a period of wet years.*** Downstream reaches also may experience slightly smaller flows as less water is routed in from upstream. As shown in **Table 3.2-12**, the recorded mean daily flow rate in Big Sandy Creek at the gage near McDade is relatively low (8.8 cfs), even when measured downstream of the permit area. Although seasonal variation and year-to-year changes dramatically depart from this mean value, these smaller flow rates are probably more sensitive to potential baseflow reductions. ~~Additional monitoring and mitigation measures may be appropriate (see mitigation measure SW-4 in Section 3.2.4.4, Monitoring and Mitigation Measures).~~

~~The effects of baseflow reduction would be most noticeable upstream of Station LBS (near McDade). Below LBS, USGS stream gage data indicate that the reach is generally losing flow to the Simsboro outcrop in its pre-mining condition. During the life of the mine, baseflow reductions largely would be outweighed by additional contributions of dewatering and depressurization discharges at TPDES Outfalls 002 and 003, as described below under Effects of Discharges to Streams.~~ ***The effects of baseflow reductions would be most noticeable in the Big Sandy tributaries upstream of a location approximately halfway between State Route (SR) 95 and U.S. Highway 290 (approximately 3 scale miles southwest of surface water discharge location 003, as shown in Figure 3.2-24 of the Draft EIS). These effects would include baseflow reductions in the tributaries overlying the Simsboro outcrop, as shown in Figure 3.2-24 of***

the Draft EIS, as well as potential effects on the Big Sandy mainstem upstream of the location described. At the former USGS stream gage on Big Sandy Creek near Elgin (gage 08159170 at SR 95), data indicate that the stream yields less water per square mile of watershed than at the station upstream near McDade (gage 08159165 at U.S. Highway 290). The potential drawdown effects on gaining stream reaches would diminish along this reach and farther downstream. During the life of the mine, baseflow reductions largely would be outweighed by additional contributions of depressurization discharges from Outfall 001 on Middle Yegua Creek and Outfall 003 on Chocolate Creek (a tributary to Big Sandy Creek). These discharges are further described below under Effects of Discharges to Streams. Given the baseflow circumstances described above, the addition of 1 to 7 or 8 cfs of depressurization discharges under the Proposed Action would compensate for drawdown effects during periods when discharges occurred. Calculations involving expected pumping, on-site consumption, and expected ranges in discharges indicate that such compensating effects would be the general case. As these flow augmentations cease at the end of mining, recharge to the Simsboro aquifer would begin. The net effect would be that some baseflow reduction would occur; however, it would be after the cessation of mining and would last until near-surface outcrop zones are recharged. The magnitude of these impacts on streamflow would vary substantially from year to year, given the wide variation in precipitation and associated near-surface recharge already typical of the region. These impacts would decrease as the aquifer recharges and may not be noticeable in wetter

than average years. However, overall, the effects from water table drawdown would have an adverse impact as a result of decreased flows on Big Sandy Creek near the permit area after mining.

Also it is likely that a portion of Middle Yegua Creek in and just upstream of the permit area would experience a measurable decline in baseflow contribution during and after mining (see **Figure 3.2-24**). Drawdown of 20 to 50 feet is projected in the Simsboro aquifer along this potentially gaining reach. The potential flow modifications would be similar to that described for Big Sandy Creek. These impacts potentially would occur upstream of TPDES Outfall 001 and likely would affect the short reach both during and after mining. Impacts to the channel section farther downstream would be alleviated during mining by discharges at the outfall. After mining and reclamation, both baseflow decreases and reductions in overall watershed yield would act together to reduce flows in the reach below Station LMY. In most seasons, these impacts largely would be alleviated by contributions from incoming tributaries along Middle Yegua between LMY and the Walleye Creek confluence. However, there also may be some decline in groundwater baseflow contributions from Sandy Creek, Grass Creek, and Walleye Creek both during and after mining. Again, the actual flow decreases are likely to be small and may be inconsequential in these channels since they normally go dry in most years under natural conditions. However, as a result of the potential effects to these smaller tributaries during and after mining, and the effects of decreasing low flows on Middle Yegua Creek near the permit area after mining, adverse impacts on surface water resources are likely to occur.

Springs and seeps that are associated with the Simsboro outcrop and that occur within the modeled drawdown area may experience a direct ***long-term*** adverse impact to water quantity, depending on their location within the drawdown area and the seasonal and annual weather conditions. Springs known to occur in the study area are shown in **Figure 3.2-24**, in combination with the projected LOM drawdown (in feet) in the Simsboro aquifer outcrop. ***In accordance with RRC regulations 16 TAC 12.130 and 12.352, Alcoa would be required to identify alternative water supplies and mitigate mine-related contamination, loss, interruption, or diminution of flows from springs on or near the proposed permit area that are used for domestic, agricultural, industrial, or other legitimate uses. Any springs or seeps that are waters of the U.S. would be mitigated in accordance with the proposed Section 404 Mitigation Plan (see Appendix E of the Final EIS). To facilitate identification of mine-related impacts to seeps and springs, the USACE is requiring additional baseline surveys of these resources (see mitigation measure SW-5 in Table 2-15 of the Final EIS).*** Springs that occur within the drawdown area of 20 feet or more likely would be affected by the proposed depressurization pumping. Only one spring, as shown in the center left portion of **Figure 3.2-24**, likely would be affected. Springs that occur in the 10- to 20-foot drawdown zones may be affected by depressurization pumping. By reasonably interpolating drawdown contours, one additional spring may be affected, as shown in **Figure 3.2-24** in the north-central part of the Simsboro outcrop. Springs that occur in areas estimated to undergo less than 10 feet of drawdown are not anticipated to be affected by depressurization pumping. In **Figure 3.2-24**, five additional springs are shown on or near the Simsboro outcrop that fit into this latter category. The Simsboro outcrop at or near these springs is anticipated to undergo approximately 5 feet (or less) of drawdown during the life of the mine.

It should be noted that springs are associated with surface exposures (outcrops) of the water-bearing formations or aquifers that supply flow to them. A number of other springs are shown in **Figure 3.2-24** that would not be affected by depressurization activities in the Simsboro aquifer. These are shown to the

northeast of McDade, in areas largely associated with the Carrizo outcrop. No springs are known to occur in the study area in association with the Calvert Bluff Formation outcrop.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described (see page 2-21 of the Final EIS) would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS). As a result, the effects to surface water resources as a result of water level changes would be the same as described in Section 3.2.4.2 of the Draft EIS.

Effects of Discharges to Streams. Estimates of total dewatering and depressurization discharges for the Three Oaks Mine are shown in **Table 3.2-13**. Industrial water demands (at the power plant and smelter) would continue to be met by the well field at the Sandow Mine. Alcoa currently proposes to use collected storm water runoff from disturbed areas and dewatering water from the Three Oaks Mine for the

Table 3.2-13
Estimated Discharges from Combined Dewatering and Depressurization Well Pumping[1]

Mine Year	Approximate Pumping Discharge (acre-feet per year)	Approximate Pumping Discharge (cubic feet/second)
1	2,800	3.9
2	2,700	3.7
3	3,500	4.8
4	5,500	7.6
5	5,300	7.3
6 - 10	5,700	7.9
11 - 15	7,400	10.2
16 - 20	9,800	13.5
21 - 25	10,600	14.6

[1]Assumes that water for dust control and other industrial uses is included and no other pumping occurs for other purposes.

Source: Hodges 2002a.

approximately 950 to 1,300 acre-feet per year of projected water usage at the mine. Excess dewatering well water and disturbance area storm water runoff volumes would be discharged through the sediment pond system. Depressurization water would be discharged from the site without routing through the sediment ponds. Also it should be noted that runoff collected in the pits would be routed through the mine storm water control system (Alcoa 2001b [Volume 5]).

Flows in Big Sandy, Chocolate, Lower Mine, and Middle Yegua Creeks would be augmented by releases from the mine water control ponds and TPDES outfalls during the life of the mine. During this 25-year operational phase, the augmentation would provide flow on a more continuous basis than under baseline conditions. These increased flows would occur for a distance of approximately 4 to 6 miles downstream of the discharge locations. This ***short-term*** augmentation would end during the closure and reclamation phase, and the streamflow regimes from rainfall-runoff events then would be as described previously under Effects from Watershed Modifications.

Three TDPES outfalls (discharge points) are proposed, and all excess water would be discharged at these outfalls to stream channels. These outfalls are shown in **Figure 3.2-24** as location 001 on Middle Yegua Creek, and locations 002 and 003 on Big Sandy Creek. With average annual runoff included in the discharge estimates, the range of releases at Outfall 001 is estimated to be 13 to 18.5 cfs (9,400 to 13,400-acre-feet per year). Including average annual runoff, the range of releases at Outfall 002 is estimated to be 0 to 1.0 cfs (0 to 725 acre-feet per year), and at Outfall 003 it is estimated to be 3.3 to 8.7 cfs (2,400 to 6,300-acre-feet per year). It should be noted that these estimates are based on average conditions; the actual rates would vary depending on pumping rates, mine water use, mitigation demands, and the occurrence of large storm events. Typical discharge rates likely would be somewhat smaller than the ranges presented but may increase substantially for periods of days or weeks following storms. During these periods, it is likely that flows in the downstream channels also would increase as a result of more widespread watershed conditions, and effects from mine discharges would be minor.

The flow rates from the discharges to the Big Sandy and Middle Yegua watersheds would not affect channel or bank morphology, nor would they increase the flooding hazard. It is ~~assumed~~ ***required by RRC regulation*** that outlet structures would be designed to ensure stream stability through the use of designs similar to those used for sediment pond outlets and diversion channels. Channel and bank morphology typically are determined by bankfull flows, which are often estimated as the peak flow having a recurrence interval of 2.33 years. These flows (on the order of 50, 500, and 3,500 cfs at proposed outfalls 002, 003, and 001, respectively) are far greater than the potential pumping discharges. Less frequent flood events (e.g., a 10-year event) are larger still, and the magnitude of channel-forming flows increases farther downstream on Big Sandy and Middle Yegua Creeks. Low-flow channels are not anticipated to be substantially modified due to the small discharge flow rates and frequently cohesive nature of the sediments. There may be slight, isolated downcutting in the low-flow portion of the main channels; however, this is not expected to contribute substantially to additional erosion and sedimentation. As stated in Section 3.2.4.1, suspended sediment concentrations in the streams vary greatly, but are substantially higher during higher flows. During the active mining phase, continuous streamflow would occur over a longer reach of channel, and water may stand temporarily in isolated pools for a longer period than prior to mine-related discharges. However, the additional flow from groundwater discharge is likely to seep into the channel bed or be taken up by evapotranspiration within several miles of the discharge point. Alcoa would mitigate impacts to low water crossings if the normal ability to cross the channel is impaired by flow increases (Alcoa 2001b [Volume 5]).

~~Reductions~~ ***The effects associated with decreases*** in surface water flows from water table drawdown, as previously described, generally would be ***minimized*** ~~outweighed~~ near the permit area by the pumping and storm water discharges during the life of the mine. These discharge rates and the locations of discharge would vary over time. It is possible that on some occasions, effects from aquifer water level changes may reduce baseflows over a short period when discharges are not occurring (or are severely limited) at one or more of the outfalls during the life of the mine. During such periods, the streamflows below the outfalls temporarily would be reduced, as previously described. This would create a temporary impact on surface water resources. ~~As a result, additional mitigation may be appropriate (see mitigation measure SW-4 in Section 3.2.4.4, Monitoring and Mitigation Measures).~~

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in minor changes to dewatering and depressurization pumpage rates (see page 2-21 of the Final EIS). As a result, there would be a related minor change in mine-related discharges to streams; however, it is anticipated that the effects to streams would be the same as described in Section 3.2.4.2 of the Draft EIS.

Surface Water Quality Impacts

Surface water quality issues associated with lignite mining generally involve the potential for increased sediment transport, nutrient and pesticide loading, and acid or toxic drainage resulting in increases in iron, manganese, or TDS. Sediment, metals, and metalloids can be treated through the use of flocculant or other chemical methods to reduce their concentration. Total dissolved solids may increase in mine area discharges, depending on the nature and timing of groundwater contributions to the sediment pond/storm water management system. All discharges during the life of the mine would be treated as necessary to meet TPDES and RRC water quality standards.

In addition to monitoring conducted for the TPDES program, surface water monitoring in compliance with the RRC permit for the Three Oaks Mine would be conducted on a quarterly and annual basis at the existing baseline monitoring sites LLS, LBS, LMY, UBS, and a new site, UMY. The existing sites are shown in Figure 3.2-21 in the Draft EIS. The placement of the new proposed site, UMY, would be on Middle Yegua Creek immediately upstream of the proposed permit boundary. Site UMY would be located approximately at the low-flow inventory site LF-12 shown in Figure 3.2-21 of the Draft EIS. Other small watersheds upstream of the permit boundary or within the proposed active mine blocks were monitored during the baseline inventory and typically do not flow. These drainages, which are not proposed for long-term monitoring, include Chocolate Creek, Mine Creek, Marshy Branch, and Willow Creek. The RRC monitoring program is outlined further in Tables C-18 and C-19 in Appendix C of the Final EIS, and would include analyses of an extensive suite of water quality parameters and constituents.

No ***short-term or long-term*** impacts to surface water quality are anticipated from dissolved or total metals, metalloids, or non-metals content in runoff or groundwater. For example, selenium levels are below laboratory detection limits in the vast majority of baseline groundwater samples (Alcoa 2000 [Volume 4]). This also is true for other constituents, as shown in baseline sampling from the Three Oaks vicinity. Water quality data from active mining conditions at the Sandow Mine also show that selenium and other constituents tested below

manufacturer recommendations***, soil test results from mandatory sampling of the recontoured surface,*** and appropriate agency regulations regarding application rates and handling of materials. Use of fertilizers and pesticides on the reclaimed areas in accordance with recommended application rates and procedures is not anticipated to constitute a risk to water quality in local streams or groundwater, based on recent water quality monitoring data from locations directly downstream of the Sandow Mine (Hodges 2002b). However, ~~nutrient-rich runoff from the reclaimed areas~~ ***the possibility exists that nutrient-rich runoff could occur from the reclaimed areas, and if it occurred, it*** could result in periodic increases in nutrient levels in nearby sediment ponds and diversions. ***If they occurred,*** ~~T~~***t***hese runoff episodes could produce corresponding increases in algal species abundance in these waters.

~~To investigate this further, Alcoa has compiled water quality data from the Sandow Mine. Data represented historical sampling from locations both upstream and downstream of the mine. Nutrient levels, particularly those constituents involving nitrogen, were minimal in the downstream samples and were not elevated beyond those in the upstream samples (Hodges 2002b). Further, during Alcoa's reclamation program at the Three Oaks Mine, fertilizers would not be applied at the frequency or intensity that they would be for agricultural crop production. As a result, water quality impacts from nutrient-enriched runoff are expected to be negligible.~~ ***To investigate this further, water quality data from the Sandow Mine were compiled and reviewed for this assessment. These data were analyzed from quarterly samples generally taken between 1991 and 2002; approximately half of the samples date from 1996. With regard to the potential for fertilizer impacts on surface water runoff, ammonia-nitrogen (N) and nitrate data were investigated. Of the available data, these represent the most common sources of fertilizer-based pollutants. Levels of both nitrogen sources were low at all but two sampling locations around the existing mine, being generally less than 0.25 mg/l with some levels on the order of 2 to 4 mg/l.***

The locations where nitrogen levels were elevated or exceeded drinking water standards for nitrite/nitrate-N (10 mg/l) were along Ham Branch at the northernmost end of the mine. The first and most upstream of these locations had sporadic ammonia-N and nitrate concentrations between 10 and 20 mg/l, although most samples contained less than 1 mg/l. All but one of the elevated values were for ammonia-N. Typically these elevated values occurred in the spring and summer, but elevated values (e.g., 24.9 mg/l) also occurred in September and October. The second site farther downstream had similar sporadic elevated concentrations of ammonia-N, but these were generally somewhat lower than the first site. The first site is located approximately 1 mile below where Ham Branch passes through the village of Praesel and by an associated sewage disposal facility. The second site is approximately another 1.5 miles farther downstream. Based on these conditions, it is believed that the elevated nitrogen concentrations have a non-mining origin. Further, during Alcoa's reclamation program, fertilizers would not be applied at the intensity typical of other agricultural crop production or residential applications. As a result, nutrient-enriched mine runoff is expected to be rare or non-existent, and related water quality impacts are anticipated to be negligible.

Water from pit dewatering and surface runoff from disturbed areas would be used for dust control (Alcoa 2001b [Volume 5]). Remaining water would be diluted with surface water runoff during higher flow events prior to release. Depressurization water from the Simsboro aquifer also would be used, as needed, to dilute water generated by pit dewatering prior to release at the TPDES outfalls. An analysis of the effects of discharging pit water through the surface water control system was conducted by RWHA. This analysis

indicates that the actual surface water quality downstream of the permit area likely would be within the range of that measured in area creeks during the baseline inventory (Alcoa 2001b [Volume 5]). ***An extensive review of water quality data from Sandow Mine discharges has been made during this impact assessment. These data were compared to baseline water quality data for both the Big Sandy Creek drainage and the Middle Yegua Creek drainage. The comparison indicates that the water quality of mine releases mimics background characteristics, particularly for constituents of interest such as total dissolved solids, chloride, sulfate, and total suspended solids. The baseline values for these constituents are shown in Table C-12 in Appendix C of the Final EIS.***

Higher background concentrations of these constituents in the locale suggests that they may be derived from a geologic source. Information from Alcoa tends to confirm that groundwater in the Calvert Bluff Formation can create higher constituent concentrations in Sandow Mine releases (Hodges 2002d). This formation would be dewatered during pit excavation at the proposed Three Oaks Mine. If the pit dewatering volume is predominantly used for dust control as proposed, only minor adverse impacts to downstream water quality would result. Protection of surface water quality would be further ensured by required TPDES and RRC monitoring programs downstream of the mine.

Selective handling of overburden and interburden would prevent acid or toxic drainage from the proposed project. Materials capable of generating acid or toxic drainage would be buried within the pit. As a result, they would not likely contribute to adverse surface water quality impacts. ***Minor amounts of materials with ABA values down to -6 could occur in the reclaimed surface soils and still be in compliance with the RRC mine permit as some of the native soils have ABAs of -6. These materials may contribute to very localized acidic conditions. The selective handling program is described in greater detail in Section 2.5.2.6 of the Final EIS, and the nature and availability of selected materials are described further in Section 3.3.2.1 of the Final EIS. In combination with the required water quality monitoring programs and permit compliance, implementation of the selective handling program would minimize the potential for adverse effects on surface water quality from geologic materials exposed during mining and reclamation. As a result, the potential for impacts from arsenic, selenium, and other water quality constituents would be minimal.*** With the exception of the two end lakes and ***portions of reconstructed drainages (including*** the RCP-1/SP-1 drainage***)***, the entire recontoured surface would be well above the pre-mining water table in the Calvert Bluff Formation (Alcoa 2000 [Volume 4], 2001b [Volume 5]). In the post-mining topographic setting, ***these reconstructed*** ~~the SP-1/ RPC-1~~ drainage**s** ~~into Mine Creek~~ would be configured to provide for surface water features and wildlife habitat (see **Figures 2-9** and **2-14**). Reclaimed land surface elevations in the drainageway***s*** would range from approximately 445 to 500 feet NGVD (Alcoa 2001b [Volume 5]). Pre-mining water levels in the Calvert Bluff Formation along the existing drainage range from approximately 448 to ~~478~~ ***490*** feet NGVD (Alcoa 2000 [Volume 4]). After mining and reclamation, the water level in the Calvert Bluff materials gradually would recover, as described under Impacts to Groundwater Levels in Section 3.2.3.2. Assuming that the recovered water level generally would mimic the pre-mining conditions, the possibility exists that isolated groundwater seeps or small springs may occur at lower elevations in the reclaimed ~~SP-1/RPC-1~~ drainageway**s**. ~~Post-mining surface flows and water quality in the Mine Creek drainage would be dominated by surface runoff from the reclaimed area, flows from the two ponds, and surface runoff from undisturbed areas farther downstream along the creek.~~ ***Small localized occurrences of surface materials with ABA values down to -6 could generate small quantities of acidic water if they coincided with these seeps. During and shortly after larger rainfall events, post-mining flows in these drainages would be dominated by runoff from***

reclaimed areas and outflows from any small ponds. In the case of the Mine Creek drainage downstream of the SP-1/RPC-1 ponds, runoff from undisturbed areas also would contribute to downstream flows. These events are not anticipated to create potential impacts to water quality. However, if seeps or springs develop in the reconstructed drainages when the water table recovers, water that is more highly influenced by oxidized overburden characteristics would be exposed and may collect in isolated locations. Such water may persist in the reconstructed drainages for longer periods than rainfall runoff would. If unsuitable overburden materials were placed near the surface in drainages, these conditions may create isolated potential impacts to surface water quality. The extent of such impacts, if they occurred, would be limited to isolated areas within reconstructed drainages on the mine area. Due to the buffering capacity of the overall geologic setting, no downstream impacts are anticipated. Because of these potential on-site impacts, additional monitoring and mitigation has been identified (see mitigation measure S-1 in Table 2-15).

Overburden/interburden analyses indicate that some unsuitable materials exist in the SP-1/RPC-1 vicinity, ***and elsewhere in the mine area***~~as identified in boreholes K4921A and K5314A~~ (Alcoa 2000 [Volume 4], 2001b [Volume 5]). ***More*** ~~S~~***s***ubstantial volumes of suitable materials for reclamation also exist in the ***mine area***~~vicinity~~. Given the prior identification of these materials and the deep burial of acid-generating or toxic materials as a result of the proposed selective handling program, any seepage that does occur **is unlikely to**~~would not have~~ come into contact with acid-generating or toxic materials. ~~High carbonate content~~ ***Adequate neutralization characteristics*** in the mixed spoil and demineralization from cation-exchange with clays in the mine spoil are anticipated to bring any water seeping from ~~reclaimed~~ ***selectively handled and tested*** Calvert Bluff ~~sources~~ ***materials*** to within the range of undisturbed background conditions in the region. This expectation is further supported by historical data from sampling ponds on Calvert Bluff spoils at the Sandow Mine. These data indicate that the pH in the Sandow ponds ranged from approximately 5.9 to 8.3 standard units, with a median value of approximately 7.4 standard units. TDS in the ponds ranged from 86 to 892 mg/l, with an average value of approximately 400 mg/l (Hodges 2002b). ***With selective handling, testing, and additional materials management if necessary,*** ~~I~~**i**t is anticipated that post-mining water quality in the ~~SP-1/ RPC-1~~ ***reconstructed*** drainage***s*** would meet applicable standards and be suitable for proposed post-mining land uses.

Alcoa proposes to use approximately 18,225 tons per year of TXU Unit 4 bottom ash for road surfacing at the proposed mine. The remainder of the Unit 4 bottom ash would be recycled or disposed of off-site. Ultimately, the proposed disposal destination of the road surfacing material is burial within the spoil at the Three Oaks Mine. This would not present a human health hazard or create additional environmental impacts with respect to surface water, since small volumes are proposed in comparison to suitable overburden/interburden and other geologic materials that would be used in recontouring as mining progresses. In addition, analytical data indicate that the Unit 4 bottom ash is free of leachable potentially toxic constituents. To ensure that any bottom ash that would be used as road surfacing material at the Three Oaks Mine would continue to meet the classification as a Class III industrial waste, the USACE has identified additional mitigation in measure SW-6 in Table 2-15 of the Final EIS.

Additional potential erosion and sedimentation impacts may result from construction of haul road crossings at streams; Alcoa proposes to mitigate the potential impacts with a storm water protection plan developed for the construction of the bridge over Middle Yegua Creek (Alcoa 2000 [Volume 14]). Additional culvert and channel stabilization ~~installations~~ ***measures*** are included in the Proposed Action for other sections of the Three Oaks-to-Sandow haul road corridor. Haul road construction is anticipated to have minor adverse impacts on drainage; however, greater impacts may occur as a result of increased erosion and sedimentation, depending on potential changes to channel cross-sections. As a result, additional mitigation may be appropriate (see mitigation measure SW-3 in Section 3.2.4.4, Monitoring and Mitigation Measures).

As discussed in Section 3.2.3.2, the Proposed Action would not affect groundwater quality in the Simsboro aquifer, which provides baseflow to some of the creeks in the area. In addition, most of the surface water flow in the study area channels and perennial pools originates from precipitation events. As a result, neither the quality of the baseflow nor the decreases in baseflow would substantially affect water quality in the gaining reaches of streams associated with the Simsboro outcrop. In addition, discharges of groundwater to streams would be required to meet applicable surface water quality standards as required by TNRCC

Based on the Carrizo aquifer's hydraulic separation from the Calvert Bluff and Simsboro aquifers, as discussed under Groundwater Quantity Impacts in Section 3.2.3.2, the projected drawdown in the Calvert Bluff and Simsboro aquifers would not affect groundwater levels or groundwater quality in the Carrizo aquifer. As a result, there would be no impact to water quality in the gaining reaches of West Yegua Creek and its tributaries, or to the quality of springs and seeps within the Carrizo outcrop area, as a result of the Proposed Action.

Effects on Surface Water Rights

No permitted surface water users are known to exist within the permit area or immediately downstream (Alcoa 2000 [Volume 5]). There may be unpermitted riparian water uses (primarily livestock watering) that occur periodically along these affected stream reaches. However, the normal flow regimes exhibit periods of dry or poorly sustained flow conditions, and Alcoa is required by regulations to address water supply and water rights impacts (TAC 2000d).

A plan for the protection of water users is included in the RRC permit application. Potential effects on surface water rights could occur as a result of changes in stream channels and watershed yield, discharges to streams, groundwater drawdown, or effects during construction and mining from the surface water control system, as discussed in other sections. The proposed activities have the potential to affect both riparian rights and other appropriated rights. However, the potential for this would be minimized or eliminated by the lack of surface water users near the project area and the requirement by RRC for effects on water supplies to be mitigated. Title 16 TAC Part 1 Chapter 12(G)(5) Rule 12.130 states that if surface mining activities may result in contamination, diminution, or interruption of an underground or surface source of water within the proposed permit area or adjacent areas which is used for domestic, agricultural, industrial, or other legitimate use, "then the application shall identify alternative sources of water supply that could be developed to replace the existing water sources, including the suitability of alternative sources for existing pre-mine and approved post-mine land uses." It is ~~assumed~~ ***required by law*** that Alcoa ~~would~~ coordinate, as necessary, with RRC and TNRCC to appropriately comply with this regulation. Therefore, impacts to surface water rights near the mine would be negligible.

Farther downstream, rights to surface water and surface water conveyances are used by individuals and civil entities such as housing developments, municipalities, and irrigation districts. These are identified in Appendix C, **Tables C-15** and **C-16**, and are largely centered in the vicinity of Somerville Lake and downstream areas. Surface water effects from the proposed project are not anticipated to reach these downstream locations, primarily due to their distance from the mine, intervening watershed factors, and the generally limited magnitude of potential surface water impacts. Surface water flow rates, timing, and water quality are affected below the project area by additional stream tributaries, aquifer characteristics, evapotranspiration, channel seepage losses, variations in rainfall, and man-made storage, withdrawals and contributions. Variations in such factors are likely to have far more effect on the availability of water at these downstream locations than would the potential impacts from the proposed project. Minimal or negligible ***short-term and long-term*** mine-related impacts to these more downstream water uses are expected.

No Action Alternative

Under the No Action Alternative, the Three Oaks Mine would not be developed. As a result, ***short-term and long-term*** impacts to surface water quantity and quality resulting from the proposed Three Oaks Mine as described above would not occur. Annual and seasonal changes in water level, flow, and water quality characteristics would continue as they have in the past. There also would be ***long-term*** potential changes associated with municipal water use.

Alternative Mine Plan

Under the Alternative Mine Plan, potential mine-related impacts to surface water quantity and quality would be the same as described for the Proposed Action (see Section 3.2.4.2 of the Draft EIS).

3.2.4.3 Cumulative Surface Water Impacts

Three Oaks without SAWS

Cumulative impacts to surface water resources would result from previous and ongoing disturbance, the cessation of discharges, and final reclamation at the Sandow Mine; construction, operation, and initiation of discharge at the Three Oaks Mine; and surface water effects associated with cumulative groundwater drawdown in the Simsboro and Calvert Bluff aquifers. These potential impacts largely would be related to the magnitude and duration of surface water flow. Cumulative surface water quality impacts would be the same as those described under direct impacts for the Three Oaks Mine. No effects from Lake Bastrop or Alcoa Lake are anticipated, and no impacts to these surface water bodies would occur.

Removal of Surface Water Features. The historical distribution of water features at the Sandow Mine is estimated by Alcoa to have included approximately 60.6 acres of wetlands and approximately 117.8 acres of other waters of the U.S., the majority of which have been removed during mining. The remaining additional disturbance of surface water features at the Sandow Mine through 2003 is shown in **Table 3.2-14**. This additional disturbance in combination with the proposed disturbance at the Three Oaks Mine, would result in approximately ~~154~~ ***161*** acres of new disturbance to surface water features. Potential ***short-term*** impacts from these activities would be mitigated by Alcoa as required by the existing Section 404 permit for the Sandow Mine and as required for the pending Section 404 permit that may be issued for the Three Oaks Mine.

Table 3.2-14
Cumulative New Disturbance to Surface Water Features at the Sandow and Three Oaks Mines

Type	Additional Proposed Disturbance Acreage at Sandow	Proposed Disturbance Acreage at Three Oaks	Total Acreage Affected
Forested wetlands	18.5	0.0	18.5
Non-forested and undifferentiated wetlands	2.2	5.3	7.5
Ponds	25.1	~~69.9~~ ***77.1***[1]	~~95.0~~***102.2***
Streams	9.4	23.6	33.0
Total	**55.2**	**~~98.8~~*106.0***	**~~154.0~~*161.2***

[1]Includes 38.5 acres of on-channel ponds and ~~31.4~~ ***38.6*** acres of off-channel ponds.

Source: Hodges 2001***, 2003***; Alcoa 2002a.

proceeds, the controls implemented during the operational phases will be converted to their final reclaimed configurations. Reclamation and revegetation will mitigate potential impacts from surface drainage, erosion, and sedimentation on the mine site and in its vicinity.

A decrease in sediment yield from the Sandow Mine area is anticipated to occur for a number of years from permanent sediment controls and revegetation (Alcoa 1999). These factors, when combined with reduced flood peaks (discussed below), may result in minor streambed shifts for short reaches of Walleye and East Yegua Creeks. These ***short-term*** impacts are not expected to be substantial, since the total sediment load in these higher tributaries is dominated by fine-textured suspended clays and silts that normally wash through with the flow. In addition, both channels represent smaller drainage areas that are joined downstream of the Sandow Mine area by additional streams (e.g., Ham Branch and Reece Branch on East Yegua, and a number of branches along Walleye Creek). The additional contributions of larger flows from undisturbed watershed areas would reduce the potential for more widespread channel effects from activities at the mine. Over the long term, additional watershed adjustments would occur on the reclaimed area and nearby. Eventually the overall flow and sediment yield conditions are expected to approximate pre-mining conditions.

The reclamation program at Sandow is anticipated to create approximately 38 post-mining impoundments and end lakes, with a surface area of approximately ~~772~~ ***747*** acres. Most of these features would be 10 acres or larger in size, and several of them would be 50 to 100 acres in size (Alcoa 1999). These features, in combination with permanent drainageway reclamation, would create additional surface water features. Following final reclamation at the Three Oaks Mine, a total of approximately ~~1,667~~ ***1,642*** acres of ponded water features eventually would be distributed on the reclaimed areas of the two mines. Additional acreages of drainageway corridors also would be restored or enhanced as outlined in Alcoa's Mitigation Plan (see Appendix E).

The creation of end lakes would result in ***long-term*** residual impacts in the form of additional surface water resources, altered sediment dynamics, and somewhat reduced watershed yields. Flows routed through the end lakes would contribute to downstream channel flows during periods of larger storm events and lower evaporation withdrawals. On average, this is likely to occur at least once a year. However, during droughts the end lakes would not discharge. This would generate an adverse impact, the effects of which may be somewhat reduced, since the nearby streams are ephemeral and likely would not have flowed during similar conditions in their pre-mining state. However, these ephemeral tributaries would flow, even in drought conditions, during precipitation events.

Based on hydrologic modeling, Sandow Mine reclamation is anticipated to reduce peak flows approximately 30 to 40 percent on East Yegua Creek upstream of U.S. Highway 77. A 10 to 14 percent peak flow reduction also is predicted for Cross Creek near the mine. However, total runoff volumes are expected to generally remain unchanged from baseline conditions (Alcoa 1999). These findings would apply to large runoff events that would occur at intervals of a year or more. For these large runoff events, the expected reduction in peak flows would result from temporary storage of flow in permanent impoundments and end lakes. Similar effects are described for the Proposed Action as a result of post-mining topography at the Three Oaks Mine. The ***long-term*** effects of post-mining topography under conditions of average rainfall and stream flow are described below.

With precipitation contributions and evaporative withdrawals, a net loss of approximately 1,760 acre-feet per year is anticipated to be evaporated from the permanent surface water impoundments and end lakes at the Sandow Mine (Alcoa 1999). Following final reclamation at the Three Oaks Mine, a net loss of approximately 1,720 acre-feet per year is anticipated to be evaporated from the permanent surface water impoundments and end lakes at that site (Alcoa 2001b [Volume 5]). As a result, a total net loss of approximately 3,480 acre-feet per year is expected as a result of evaporation from open-water surfaces at the combined reclaimed sites. For comparison, current evaporative losses at Somerville Lake, assuming normal pool elevation, are approximately 19,000 acre-feet per year. Total evaporative losses in combination with storage and routing effects from the end lakes may create minor adverse impacts on downstream users. At most, the combined average effect may be to reduce downstream surface water yields by approximately 4 to 5 percent for Middle Yegua Creek, 1 to 2 percent for East Yegua Creek, and 12 percent for Big Sandy Creek. These estimates are based on regional watershed yield estimates and are for purposes of comparison only. The actual reduction in surface water yields likely would be less than these values, since the end lakes would discharge under favorable rainfall conditions, and these flows would pass through the downstream undisturbed watersheds under channel conditions that are the same as historical conditions. Most of the watershed area that would be controlled by the end lakes currently is drained by ephemeral channels that have contributed limited yields to downstream locations in the past. Evapotranspiration, aquifer conditions, seepage from the channels, and man-made withdrawals and contributions historically have affected such flows and would continue to do so. The existing large evaporative losses from Somerville Lake and the ongoing water supply management at that facility would outweigh the minimal relative effects of minor impacts from the mine. Along Big Sandy Creek, losing reaches occur where surface water ***is either lost to evapotranspiration or*** infiltrates out of the channel and into the Simsboro outcrop. This is evident in comparing historical gaging data for the USGS stations near Elgin and McDade. Such pre-mining flow losses still would apply in the post-mining phase and would minimize the overall effects of end lake controls on watershed yield in Big Sandy Creek, since the flows may be lost to the aquifer or to evapotranspiration downstream, under pre-mining conditions.

As a result of recontouring during reclamation at both the Sandow Mine and the proposed Three Oaks Mine, approximately 22 square miles of watershed area would provide controlled contributions to downstream flows. Approximately 15.3 square miles of drainage area controlled by the end lakes would occur under the proposed Three Oaks reclamation configuration, and approximately 6.8 square miles would occur from Sandow. Approximately 6.4 square miles would be located in the Big Sandy watershed, approximately 11.7 square miles would occur in the Middle Yegua watershed, and approximately 4 square miles would occur in the East Yegua Creek watershed. In addition, approximately 11.5 square miles of watershed area drains to Alcoa Lake; however, this facility existed before USGS gaging started in the area in the early 1960s. Therefore, its effects are already included in the historical flow records that comprise the baseline condition.

These watershed modifications would not occur until after recontouring and reclamation at the mines. Effects of watershed modifications at Three Oaks are discussed as direct impacts under the Proposed Action (see Section 3.2.4.2). The effects from watershed modifications at Sandow will happen within the next 5 to 10 years and will consist of smaller flow rates and somewhat reduced flow durations on the intermittent or ephemeral reaches nearest the mine. Downstream of Sandow, additional tributaries join the

Although recovery would occur in the proposed Three Oaks Mine vicinity after the cessation of mine-related pumping, estimated drawdowns for the years 2030 and 2050 still would range from approximately 30 to 60 feet in the Simsboro outcrop areas that likely contribute baseflow to the Big Sandy drainage and to Middle Yegua Creek. From a surface water perspective, the potential depths of drawdown still would be substantial enough under these later conditions to affect flows in drainages across the Simsboro outcrop in the area between the Colorado River and the Sandow Mine, as described. It is assumed that non-mining related pumping and its associated drawdown effects would exist in perpetuity.

Effects of Discharges to Streams. In recent years, an estimated combined annual average of approximately 28 cfs (20,300 acre-feet) has been discharged from the Sandow Mine into Walleye and East Yegua Creeks as a result of groundwater management at that mine. Walleye Creek joins Middle Yegua Creek several miles downstream of the discharge point. Historically, these discharges likely have been the source of prolonged low flows in the reaches of these streams near the mine. Depending on the actual discharge volume at one time and its distribution between the creeks, augmented flows likely have occurred for 10 to 15 miles downstream of the discharge points, as implied by baseline inventory data in lower Walleye Creek and USGS gage records for East Yegua Creek. The amount of augmentation on downstream reaches ranges between 8 and 12 cfs on Walleye Creek near the mine and decreases downstream due to seepage losses and evapotranspiration. The amount of augmentation on East Yegua Creek is approximately 20 to 25 cfs. These flows likely varied as a result of pumping and discharge changes at the Sandow Mine. These activities have affected surface water resources over the past decade or more.

The cessation of Sandow Mine dewatering and depressurization discharges would end artificial flow augmentation in East Yegua and lower Walleye Creeks in approximately 2005. As a result, flows in the augmented reaches would return from an essentially perennial regime to their original ephemeral or intermittent regime. Given that the affected stream reaches are relatively high in the watershed, it is likely that flows would cease during the summer and fall and during droughts, as do flows in undisturbed streams in similar nearby settings. Small intermittent or perennial pools may remain along isolated stretches of the channels during these dry periods. The end of augmentation would contribute to combined impacts on surface water resources as discussed below.

Flows in Middle Yegua Creek would not be affected by the end of Sandow Mine discharge into Walleye Creek until after the year 2030, when similar discharges from Three Oaks would end. Until that time, discharges from dewatering and depressurization pumping would augment Middle Yegua Creek below monitoring station LMY, and Big Sandy Creek below station UBS and Chocolate Creek as discussed under direct impacts for the Proposed Action (Section 3.2.4.2). As discussed, three TDPES outfalls are proposed for the Three Oaks Mine. All excess water would be discharged at these outfalls to Middle Yegua Creek and Big Sandy Creek. With average annual runoff included in the discharge estimates, the range of releases into Middle Yegua is estimated to be 13 to 18.5 cfs (9,400 to 13,400 acre-feet per year). Including average annual runoff, the overall range of combined releases into lower Big Sandy is estimated to be 3.3 to 9.7 cfs (2,400 to 7,000 acre-feet per year). It should be noted that these estimates are based on average conditions; the actual rates could vary substantially from these estimates depending on pumping rates, mine water use, mitigation demands, and the occurrence of large storm events. Typical discharge rates likely would be somewhat smaller than the ranges presented; however, it may increase substantially for periods of days or weeks following storms. During these events, native flows in the downstream channels also would

be larger. Regionally, this partially would offset the effects from cessation of discharges at Sandow until the year 2030, and until that year it would outweigh the effects of groundwater drawdown on the main channels of Big Sandy Creek and Middle Yegua Creek. ***After that time, drawdown effects on baseflows would occur over the long term, as described previously.***

The creek channels along the Big Sandy drainage are small and have limited conveyance capacity. Flows tend to back up along the creeks and tributaries because of this. Because homes, a school, and private property improvements occur in or near the FEMA Zone A delineations along this channel system, impacts were assessed with respect to potential combined effects from Three Oaks depressurization discharges and reasonably expected discharges from brick manufacturing facilities. Since depressurization discharges are likely to occur over extended periods of time, the potential cumulative discharges could fill the channels and inundate small areas in the adjacent overbanks. This potential was investigated using surveyed cross-sectional data from the HEC-RAS modeling, with cumulative discharge inputs based on a potential combined brickyard and depressurization discharge into Chocolate Creek (15 cfs). The results were essentially the same as those described for the Proposed Action, with only small increases in depths, widths, and flow velocities. Potential impacts and mitigation would be the same as those described for the Proposed Action.

Effects on Surface Water Rights. The potential effects on surface water rights under this cumulative scenario would be similar to those discussed under the Proposed Action (see Section 3.2.4.2). A slight increase in adverse effects on downstream water users may be anticipated beyond those described for the Proposed Action. This would result from combined evaporative effects in the Three Oaks Mine and Sandow Mine end lakes, as discussed previously in this cumulative scenario under Effects from Watershed Modifications. As discussed previously under the Proposed Action, RRC regulations require Alcoa to mitigate adverse effects on water supplies. Therefore, cumulative effects on surface water rights under the Three Oaks without SAWS scenario would be minimized.

Three Oaks with SAWS

Potential impacts to surface water resources under this scenario would be similar to those discussed for Three Oaks without SAWS, except that the quantity of water pumped for SAWS would correspondingly reduce the quantity of water to be pumped for mine depressurization. Potential impacts from groundwater drawdown also would be similar; however, increased water supply pumping with SAWS would have a regional effect on gaining stream segments that occur northward along the Simsboro outcrop. No surface water quality impacts are anticipated.

Removal of Surface Water Features. These activities and their effects would be the same as those described for Three Oaks without SAWS.

Effects from Watershed Modifications. The effects on streamflow from watershed modification would parallel those described for the Three Oaks without SAWS scenario.

Effects to Surface Water Resources from Water Level Change. Under this scenario, the projected ***long-term*** effects to surface water resources from water table drawdown would be essentially the same as those

Effects of Discharges to Streams. Prior to 2013, the potential effects to surface waters as a result of discharge would be the same as described above for the Three Oaks without SAWS scenario. In 2013, SAWS would begin to withdraw groundwater from the Three Oaks Mine area. Given current estimates of depressurization pumpage, dewatering pumpage, and localized industrial uses (e.g., mine dust control), on average, this would result in removing the discharge contributions from the main channels of Big Sandy Creek and Middle Yegua Creek at the proposed TPDES outfalls. It should be noted that in periods of high runoff, substantial discharges from the mine water management system still would occur, and these essentially would maintain the intermittent flow character of the downstream channels during the life of the mine.

The combined effects on Big Sandy Creek and Middle Yegua Creek would include greater flow below the outfalls until Three Oaks stops discharging depressurization water in the year 2013. Between 2013 and 2030, late-season flows and the occurrence of perennial pools on or near gaining reaches likely would decrease or cease on both drainages as a result of drawdown. After the year 2030, the cumulative effects described for surface water resources generally would act in combination on Big Sandy and Middle Yegua Creeks. Flows and perennial pools in these channels substantially would be reduced by ~~a combination of watershed yield decreases~~ ***evaporation, watershed routing changes,*** and groundwater drawdown effects on baseflow contributions from the Simsboro aquifer. These ***long-term*** impacts would be most noticeable near the proposed Three Oaks Mine permit area and for several miles downstream on both creeks. It is conceivable that average flow reductions of 25 percent or more could occur in these areas. As a result, seasonal impacts could be greater. Potential impacts from the Three Oaks Mine in these areas gradually would be alleviated after 2030 as the Simsboro aquifer recovers in the immediate vicinity of the Three Oaks Mine. However, throughout the watersheds in general, such alleviation would be offset by increasing drawdown from water supply pumping. It is assumed that the municipal water supply pumping and its associated drawdown effects would exist in perpetuity.

East Yegua Creek would be affected by watershed modifications and the cessation of discharges at the Sandow Mine. Flows would be substantially reduced near the mine from their existing artificially augmented condition. These impacts would be greatest upstream of State Route 77; however, some decreases in flow and the size and duration of perennial pools downstream of this location could occur. These effects would result from the change in the augmented flow conditions that have existed from Sandow Mine discharges.

Effects on Surface Water Rights. No surface water users are recorded along the Yegua system channels in the mining vicinity. Thus, no ***short-term or long-term*** effects are anticipated on Big Sandy, Middle Yegua, and East Yegua Creeks from operations and reclamation activities at the existing Sandow Mine or the proposed Three Oaks Mine. Riparian uses may temporarily benefit from additional flows along Big Sandy and Middle Yegua Creeks as a result of Three Oaks Mine discharges. After reclamation at Sandow and Three Oaks, restored water features likely would offset potential impacts to riparian uses. Riparian rights that are adversely affected by mine-related groundwater drawdown would be mitigated or compensated for by Alcoa in accordance with RRC regulations. On the Big Sandy and Middle Yegua drainages, both riparian uses and any recorded water rights may be adversely affected after the year 2030 by groundwater drawdown induced by SAWS and other municipal pumping, as discussed below for the cumulative No Action Alternative (SAWS without Three Oaks).

The potential for more widespread impacts to surface water resources from mine watershed modifications or surface water discharge would be extremely limited. At Somerville Lake and below, USACE reservoir operations determine the Yegua Creek flow conditions downstream to the Brazos River and associated irrigated lands. The watershed area contributing to Somerville Lake is approximately 1,003 square miles, and the restricted drainage areas affected by Alcoa's post-mining topography areas represent slightly over 2 percent of that area. These effects would have a minor adverse impact on downstream water users, since their magnitude is small relative to overall watershed yield. In fact, most downstream users are recorded at locations much farther downstream in the watersheds and are hydraulically separated from the mined areas by stream reaches in all three creeks that frequently go dry in the late summer and fall.

Regional cumulative impacts on surface water resources from SAWS and municipal pumping may result in ***long-term*** adverse effects on surface water rights. These impacts would be addressed through state, regional, or local water management authorities. Riparian and other surface water rights along the Big Sandy and Middle Yegua drainages and their tributaries in the vicinity of the Simsboro outcrop would be adversely affected by groundwater drawdown impacts from SAWS and other pumping. On average, these impacts would decrease the volume of water available and shorten the duration of use. During any critical future drought period in which surface water rights are tested, those groundwater contribution areas of Big Sandy Creek most likely to be affected probably do not contribute to any flows in the Colorado River. In addition, when they presently do contribute to Colorado River flows (in the winter and early spring months), the flows are so small compared to target Colorado River flows at Bastrop that any effects are minimal. As a result, water rights impacts on the Colorado River would not occur under this scenario.

SAWS without Three Oaks (No Action Alternative)

The potential surface water impacts under the SAWS without Three Oaks scenario relate to effects on streamflow magnitudes and durations as a result of water supply pumping. Little or no impacts on surface water quality are anticipated.

Removal of Surface Water Features. Under this scenario, removal of existing surface water features only would occur at the Sandow Mine. Acreages of disturbance to surface water features at the Sandow Mine is estimated to include a total disturbance of approximately 117.8 acres of ponds and ephemeral/intermittent streams. The direct loss of these resources would be mitigated in accordance with Alcoa's existing permits.

Effects from Watershed Modifications. Effects on streamflows from watershed modifications at the Sandow Mine would be the same as described under the Three Oaks without SAWS scenario. No watershed modifications would occur at Three Oaks Mine as the mine would not be developed.

Effects to Surface Water Resources from Water Level Change. In the area between the Colorado River on the south and the Sandow Mine on the north, the projected effects on surface water resources from water table drawdown under this scenario would be similar to those discussed for Three Oaks with and without SAWS. Large areas experiencing drawdown over 20 feet are projected in areas of gaining stream channels, springs, and reaches that could experience seepage losses. The occurrence of these areas would be similar to the cumulative scenarios described above for Three Oaks with and without SAWS as Three Oaks Mine pumpage would have little effect in these areas.

On a more regional basis, flow contributions from the Big Sandy into the Colorado River near Bastrop would ***experience long-term*** decline as a result of extensive drawdown from SAWS and municipal water supply pumping in the Simsboro aquifer, as described for the Three Oaks with SAWS scenario. Regional pumping would affect surface water baseflows northeastward along the Simsboro outcrop into Milam, Robertson, Falls, and Limestone Counties. It is assumed that pumping for SAWS and other water supplies would occur in perpetuity, and thus the associated drawdown effects on surface water resources would as well.

Effects of Discharge to Streams. Under this scenario, discharges from Sandow Mine dewatering and depressurization groundwater pumpage to East Yegua Creek and lower Walleye Creek would cease in approximately 2005. As a result, flows in augmented reaches would return to their original ephemeral or intermittent regime, with small intermittent or perennial pools potentially remaining in isolated stretches. No discharge from the Three Oaks Mine would occur, as the mine would not be developed.

Effects on Surface Water Rights. As described for Three Oaks with SAWS, ***long-term*** adverse impacts on surface water rights may result from regional cumulative impacts. Riparian and other surface water rights along Big Sandy Creek, Middle Yegua Creek, and their tributaries in the vicinity of the Simsboro outcrop would be adversely affected by groundwater drawdown impacts from SAWS and municipal pumping. These impacts would be similar to those described under the Three Oaks with SAWS scenario. The impacts could be mitigated through water resources management alternatives by local and regional authorities.

3.2.4.4 Monitoring and Mitigation Measures

SW-1: End Lake Shoreline Mitigation. ~~During final design and implementation of end lake construction and reclamation at the proposed Three Oaks Mine, the USACE and other appropriate resource agencies would be consulted with regard to grading and recontouring along the projected shoreline margins. This consultation~~ ***End lakes would be constructed with a minimum of one lower floodplain terrace along the spoil-side shoreline that is designed at an elevation to be frequently flooded. When topography allows, the end lake shoreline would be designed to include a second terrace that is flooded seasonally. To mimic natural conditions and to prevent erosion, sideslopes would be gentle (greater than 7H:1V). Native tree, shrub, and herbaceous species would be planted throughout the planting bench and terraces, based on their inundation tolerance. Recommended species are provided in Table 6.2 of the Mitigation Plan (see Appendix E of the Final EIS).***

Alcoa would provide the USACE and TPWD a copy of detailed design plans for end lakes upon submittal to the RRC, and Alcoa would invite these agencies to comment on the designs with regard to grading and recontouring along the projected spoil-side shoreline margins. Alcoa's commitment to developing quality wildlife habitat and this consultation would ensure adequate inundation of ***large portions of*** the shoreline under conditions of fluctuating end lake water levels for the protection of surface water users.

SW-2: End Lake Outlet***s***/Channel Mitigation. ~~During final design and implementation of end lake construction and reclamation at the proposed Three Oaks Mine, the outlet spillways and downstream channel protection measures would be configured and implemented so as to minimize the potential for channel degradation and downstream sedimentation. The measures would be constructed so as to provide long-term channel protection.~~ ***Outlet spillways for all structures would be designed to minimize the***

potential for erosion and downstream sedimentation. This is a requirement of the Surface Coal Mining Regulations, and the RRC reviews each structure for compliance with §12.345 of the regulations, Hydraulic Balance: Discharge Structures. Specifically,

> ***Drainage from sedimentation ponds, permanent and temporary impoundments, coal processing waste dams and embankments, and diversions shall be controlled by energy dissipaters, riprap channels, and other devices, where necessary, to reduce erosion, to prevent deepening or enlargement of stream channels, and to minimize disturbance of the hydrologic balance. Discharge structures shall be designed according to standard engineering-design procedures.***

Cross-sectional surveys of the unnamed south tributary to Chocolate Creek would be conducted immediately prior to reclamation activities involving the South End Lake. Additional channel configuration monitoring downstream of the permit area would be conducted during the reclamation monitoring period prior to bond release. The South End Lake outlet would be configured to minimize flooding from the 2-year storm event and larger events in the areas downstream along the unnamed tributary. Channel stabilization along that tributary and Chocolate Creek would be undertaken, as needed, during the reclamation monitoring period to minimize the potential long-term effects of channel instability.

Downstream cross-sectional surveys and channel geomorphological assessments would be conducted in the field immediately prior to reclamation activities involving construction of the end lake spillways and outfalls. A historical series of aerial photographs may be employed in addition to these investigations. The stream reaches involved would include Chocolate Creek and its unnamed north and south tributaries as utilized to convey discharges from a series of smaller ponds and the South End Lake, respectively; Big Sandy Creek from immediately upstream of its confluence with the aforementioned tributary and downstream to monitoring station LBS; and Mine Creek and the tributary of Mine Creek below the outfall of the proposed North End Lake. Alcoa would coordinate to obtain access permission from landowners for these activities. If it is determined through interactions with the USACE that the existing channel sizes and configurations are inappropriate for the post-construction conveyance requirements, Alcoa would be required to perform work to ensure long-term channel stability under the dominant channel-forming discharge. End lake and pond series outlets to receiving streams would be configured so as not to create significantly damaging increases in downstream predicted surface water elevations from a 2-year, 24-hour storm event. Predicted downstream water surface elevations for the 100-year, 24-hour storm event would not be increased more than 1.0 foot above modeled baseline conditions in the areas downstream. Overall efforts may include channel realignment or stabilization, preferably incorporating biostabilization methods, subject to landowner permission for access and disturbance. Additional channel configuration and erosion and sedimentation monitoring downstream of the permit area would be conducted during the reclamation monitoring period prior to bond release, and modifications to any stabilization efforts would be made, as necessary.

SW-3: Stream Crossing Mitigation. During ~~final~~ design and construction of culverts and bridge crossings for the proposed Three Oaks Mine, ~~TNRCC and USACE would be consulted to avoid adverse changes to stream channel cross-sectional geometry and to coordinate the review and approval of BMPs. This would~~

~~be done in order to minimize adverse impacts from erosion, sedimentation, and potential effects on aquatic habitat features due to cross-sectional or longitudinal modifications.~~ ***Alcoa would adopt the following general conditions in addition to the design criteria and performance standards required by the Surface Coal Mining Regulations:***

a. Proper Maintenance. Bridges and culverts shall be properly maintained, including maintenance to ensure public safety.

b. Erosion and Sediment Controls. Appropriate soil erosion and sediment controls will be used and maintained in effective operating condition during construction, and all exposed soil and other fills as well as any work below the ordinary high water mark must be permanently stabilized at the earliest practicable date. Construction will be planned during periods of low-flow or no-flow.

c. Water Quality. Alcoa will provide water-quality management measures that will ensure that the authorized work does not result in more than minimal degradation of water quality. Such measures will include the implementation of BMPs such as disturbing the smallest practicable area for the project, using straw dikes, riprap, check dams, mulches, vegetative sediment filters, and other measures to reduce overland flow velocity, reduce runoff volume or trap sediment.

d. Suitable Material. No activity within waters of the U.S. may consist of unsuitable materials, such as trash, debris, car bodies, etc.

e. Management of Water Flows. To the extent practicable, the bridge or culvert will be designed to maintain preconstruction downstream flow conditions. Furthermore, the structure must not permanently restrict or impede the passage of normal or expected high flows, and the structure must withstand expected high flows. Stream channelizing will be reduced to the minimal amount necessary, and the design and construction of the culvert or bridge must, to the extent practicable, reduce adverse effects such as flooding or erosion downstream and upstream of the project site.

f. Adverse Effects from Impoundments. If construction of a bridge or culvert creates an impoundment of water, adverse effects to the aquatic system due to the acceleration of the passage of water and/or the restricting of its flow shall be minimized to the maximum extent practicable.

g. Removal of Temporary Fills. Any temporary fills must be removed in their entirety and the affected areas returned to their pre-existing condition.

h. Fills Within 100-Year Floodplains. Alcoa must comply with any applicable FEMA-approved state or local floodplain management requirements.

SW-4: Surface Water Flow Mitigation. ~~Alcoa would coordinate and plan pumping discharges through the TPDES outfalls for the proposed Three Oaks Mine in a manner to provide continuous surface flows at the three outfalls to the degree possible during low-flow periods. The purpose of such coordination and planning~~

~~would be to alleviate the potential impacts of groundwater drawdown on surface water low flows during the active mining phase.~~ ***Based on further evaluation, the USACE has determined that mitigation measure SW-4 as presented in the Draft EIS, which would have required artificial flow augmentation below the proposed TPDES outfalls, should be eliminated from further consideration as it would result in unnatural stream flow conditions during the life of the mine. Alternatively, elimination of this measure would provide for the continuation of conditions similar to existing pre-mining intermittent flows.***

SW-5: Spring and Seep Mitigation. Prior to the initiation of dewatering or depressurization operations, Alcoa would conduct an additional baseline spring and seep survey of the permit area and surrounding locale. The survey would be conducted in the outcrop areas of the Calvert Bluff and Simsboro Formations. The aerial extent and methodology of the survey would be determined through coordination with the USACE, TCEQ, and TPWD. The survey would consist of site visits using access permission obtained from appropriate landowners. These visits would include landowner interviews to the extent possible. Supplemental survey methods, such as examination of aerial imagery, would be incorporated as necessary. A written report identifying the locations and areas of springs and seeps, their primary uses, and their seasons of occurrence or flow (as appropriate) would be developed and submitted to the agencies identified above. If mine-related impacts occur to springs, they would be mitigated in accordance with RRC and USACE regulatory requirements.

SW-6: Bottom Ash Recharacterization Monitoring. Periodic recharacterization of Unit 4 bottom ash would be conducted (for years in which Alcoa intends to use bottom ash at the Three Oaks Mine) on an annual basis from multiple representative samples, and would include analyses for leachable concentrations of arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The analytical methods and reporting procedures to be implemented would be those required by TCEQ to verify continued classification as a Class III industrial waste.

3.2.4.5 Residual Adverse Effects

The creation of end lakes in the final reclaimed configuration would control the discharge of storm runoff in adjacent downstream portions of Willow Creek, upper Mine Creek, and Chocolate Creek. The amount and timing of storm runoff in these ephemeral streams would be modified from the pre-mining conditions. Average annual surface water yields along Mine Creek and Chocolate Creek are predicted to be somewhat reduced. These effects would diminish downstream as storm flows from undisturbed tributaries contribute to yields from the larger watershed areas. The end lakes themselves would change the nature of existing surface water resources from geographically distributed small streams and ponds to that of relatively larger, deeper features on the reclaimed surface. These ***long-term*** effects would be somewhat reduced by the establishment of drainage features and ponds as reclamation proceeds.

The predicted water table drawdown from dewatering and depressurization pumping would reduce baseflow contributions in stream reaches where such flows occur. These ***long-term*** effects are most likely to occur on isolated stream channels overlying the Simsboro outcrop, and in channels immediately downstream from such reaches. Elsewhere in the study area, most stream flows are supported by rainfall runoff. Flow reductions would be most notable in the areas of groundwater contributions during seasonal low-flow

that occur outside of the proposed disturbance area, but within the study area, were identified based on National Wetland Inventory (NWI) maps developed by the USFWS. Waters of the U.S., including wetlands, identified on these maps have not been field verified. Based on data review and field surveys, 10 wetlands comprising approximately 9 acres occur within the study area. Within the proposed disturbance area, the field surveys identified approximately 198,4***18***~~81~~ linear feet of waters of the U.S. (i.e., ephemeral and intermittent creeks) totaling approximately 23.6 acres. ***Of this length, approximately 70,545 linear feet are located in the Colorado River watershed and 127,873 linear feet are within the Brazos River watershed.*** Additionally, there are approximately 38.5 acres of on-channel ponds and 5.3 acres of wetlands located within the proposed disturbance area (Hodges 2002b). Review of NWI and USGS topographic maps indicate that within the portion of the study area located outside of the proposed disturbance area, there are approximately 78,000 linear feet of waters of the U.S. Field surveys of this area were limited by lack of access. Based on limited field observations plus interpretation of color infrared aerial photography, this portion of the Simsboro outcrop outside of the permit area was estimated to contain approximately 73.5 acres of waters of the U.S. (Horizon 2002). As a result, a total of approximately 276,4***18***~~81~~ linear feet of ephemeral and intermittent stream channel qualifying as waters of the U.S. and totaling approximately 140.4 acres are estimated to occur within the study area (**Figure 3.2-26**).

The majority of wetlands observed within the permit area were classified as palustrine emergent wetlands associated with depressions adjacent to intermittent creeks or fringe areas along the edges of stock pond embankments or roadways (Horizon 2000). Dominant herbaceous species observed within these wetlands included smartweed (*Polygonum* spp.), spikerush (*Eleocharis* spp.), flatsedge (*Cyperus* spp.), and rush (*Juncus* spp.). Tree and shrub species occasionally observed in the wetlands included black willow (*Salix nigra*), eastern cottonwood (*Populus deltoides*), sugar hackberry (*Celtis laevigata*), and cedar elm (*Ulmus crassifolia*). Wetland soils primarily consisted of clayey sands that exhibited distinctive hydric characteristics (e.g., mottling) (Horizon 2000). Wetland vegetation is discussed further in Section 3.4.1.1, Vegetation Types.

Riparian woodlands within the permit area are located along the edges of intermittent and ephemeral streams. These riparian corridors are characterized by a dense overstory canopy and a well developed understory consisting of a variety of shrub and herbaceous species. These riparian woodlands did not meet the requirements for waters of the U.S. (Horizon 2000). An additional description of riparian woodlands is provided in Section 3.4.1.1, Vegetation Types.

The cumulative effects area for waters of the U.S., including wetlands, includes the proposed Three Oaks Mine disturbance area; the projected interrelated actions' 10-foot groundwater drawdown area within the Simsboro aquifer outcrop; segments of Big Sandy, Middle Yegua, and East Yegua Creeks extending approximately 6 miles downstream from the points of discharge from interrelated actions; and areas of surface disturbance associated with interrelated actions (**Figure 2-15**). Wetlands within the cumulative effects area were evaluated using NWI maps, color infrared photography, and field survey data, where available. Review of the NWI maps and aerial imagery indicates the presence of numerous stock pond impoundments in the region, as was observed during field surveys within the permit area. These total approximately 31.4 acres within the proposed disturbance area. The isolated stock ponds observed within the permit area generally do not support wetland vegetation and were assessed as being non-jurisdictional (Horizon 2000). Review of maps and photos for the 10-foot drawdown area of the Simsboro aquifer outcrop indicated that the majority of stock ponds in this area also are isolated off-channel ponds that would not

meet the definition of waters of the U.S. (Horizon 2002). Most of these ponds had limited vegetation around their perimeters, while a few had substantial stands of hydrophytic vegetation. The majority of wetlands identified within the cumulative effects area are small, isolated emergent wetlands. It is assumed that the conditions within these wetlands are similar to the conditions identified in the wetlands delineated within the permit area. Ephemeral and intermittent channels also occur within the cumulative effects area. Due to the lack of access, field verification of NWI mapped waters of the U.S., including wetlands, within the cumulative effects area could not be performed (other than within the permit area). However, as the majority of channels in the region are intermittent or ephemeral, the streams are likely to be waters of the U.S. It is assumed that insufficient streamflow exists to sustain riparian wetland corridors adjacent to ephemeral and intermittent streams outside of the permit area other than along the segments of Walleye and East Yegua Creeks that currently receive flow from Sandow Mine groundwater discharge.

3.2.5.2 Environmental Consequences

Proposed Action

Physical Disturbance, Removal, and Replacement of Waters of the U.S. Including Wetlands. A total of 8.7 acres of wetlands, all of which are waters of the U.S., occur within the permit area, of which 5.3 acres would be adversely affected as a result of mine construction and operation. The direct impacts would occur as a result of mine pit construction and development of ancillary facilities, including haul roads, conveyors, storage buildings, parking lots, and storm water control structures. A total of 67.4 acres of waters of the U.S., including 19.9 acres of ephemeral stream channels, 3.7 acres of intermittent stream channels, and 38.5 acres of on-channel ponds also would be directly impacted during mine operation. Waters of the U.S., including wetlands, that would be affected within the permit area are shown in **Figure 3.2-25**. These impacts would be minimized through implementation of the proposed reclamation program that would be initiated following backfill of the initial mine pit and would continue concurrent with mine operations. As discussed in Section 2.5.3.6, Restoration of Waters of the U.S. Including Wetlands, and as contained in Alcoa's draft Mitigation Plan (Appendix E), the goal of the reclamation program for wetlands, riparian woodland, and surface water features is to create features of similar nature and function to those existing prior to mining. Alcoa's mitigation of waters of the U.S., including wetlands, would involve a combination of onsite replacement of features removed within the area disturbed by mining plus creation or enhancement of additional features in an offsite protected area along Mine Creek and Middle Yegua Creek (the Middle Yegua Mitigation Site).

Direct impacts to low-quality ephemeral streams would be mitigated at a minimum ~~replacement~~ ratio of 1:1 (based on ***both*** the area ***and length*** of affected stream channel***s***) (see Section 3.2.4.2). Medium-quality streams would be mitigated at a minimum ratio of 1.5:1. High-quality streams and herbaceous wetlands would be replaced at a minimum ratio of 2:1. On-channel ponds (qualifying as waters of the U.S.) would be reclaimed at a minimum ratio of 1.5:1. ~~Temporal impacts would be mitigated at a ratio of 0.5:1.~~ Based on these mitigation ratios, the total proposed mitigation acreage for direct impacts would include restoration of at least ~~23.6~~ ***33.9*** acres of stream channel, ~~5.3~~ ***10.6*** acres of wetlands, and 57.8 acres of on-channel ponds**.** ~~within the reclaimed mine area plus creation of 5.3 acres of new wetlands and 20.6 acres of stream channel/riparian enhancement in the Middle Yegua Mitigation Site. The total proposed mitigation acreage for temporal impacts would include~~

~~23.6 acres of stream channel/riparian enhancement and 2.7 acres of new wetlands in the Middle Yegua Mitigation Site.~~

The temporary loss of 5.3 acres of wetlands during mining operations would result in the loss of the functions associated with each area (e.g., runoff and sediment retention), affecting water quality. This loss would be mitigated by creation ~~of 8.0 acres~~ of additional wetlands in the Middle Yegua ~~Creek m~~ ***Mitigation*** ~~s~~ ***Site and Big Sandy Mitigation Site*** and restoration after mining of ~~5.3 acres of~~ wetlands in the disturbance area. Additionally, the removal of jurisdictional streams would reduce the available flow pathways for runoff water. However, the implementation of storm water management plans, including the construction of sediment ponds and diversion channels, likely would provide comparable or greater storm water management capacities than the affected waters of the U.S. In addition, Alcoa's commitment to mitigation for intermittent and ephemeral streams that are waters of the U.S. and on-channel ponds would further enhance runoff and sediment retention at the mine site. The net increase in wetlands following reclamation would provide for additional capture of runoff and increased storm water and sediment retention.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, potentially would eliminate mine-related stream channel disturbance in the upper reach of one tributary to Willow Creek and portions of two tributaries to Chocolate Creek. Also, this modification potentially could result in additional stream channel disturbance to the upper reaches of one of the tributaries to Chocolate Creek, depending on where the southeastern boundary of the mine area would be extended to offset the exclusion areas. If affected, this tributary would be evaluated by Alcoa in coordination with the USACE, and the applicable mitigation ratio would be applied as discussed in Section 3.2.5.2 of the Draft EIS. Effects to other waters of the U.S. (wetlands) would be the same as described in Section 3.2.5.2 of the Draft EIS.

Water Quantity Impacts. Dewatering of the Calvert Bluff aquifer would be limited to isolated sand lenses in the lower third of the Calvert Bluff Formation. As discussed under Groundwater Quantity Impacts in Section 3.2.3.2, groundwater drawdown associated with dewatering activities would be restricted to the lower portion of the aquifer based on modeling results. Due to the general lack of sand in the Calvert Bluff and the lack of surface waters supported by the Calvert Bluff water table, groundwater drawdown in the Calvert Bluff aquifer would not affect surface water features, including waters of the U.S. Depressurization of the Simsboro aquifer would occur during the life of the mine. As the Simsboro aquifer is confined well below the surface within the permit area, impacts to surface water features, including wetlands, within the permit area are not anticipated from Simsboro aquifer depressurization (see Section 3.2.3.2). Groundwater drawdown would occur within the Simsboro aquifer outcrop, located adjacent to the northwest boundary of the permit area. The anticipated drawdown within the outcrop area could reach a depth of 10 feet within the 10-foot drawdown area of the Simsboro outcrop. Field delineations of wetlands within the Simsboro outcrop area were not conducted; however, NWI maps and aerial imagery were reviewed to determine the number and extent of wetlands within the groundwater drawdown area of 10 feet and greater in order to estimate the potential impacts to wetlands. Based on this review, approximately 5.2 acres of jurisdictional wetlands that potentially could be affected by ***long-term*** water level changes in the Simsboro outcrop were identified. In addition, seven riparian corridors associated with gaining stream reaches in the 10-foot drawdown area of

the Simsboro outcrop, as identified from NWI maps, potentially would ***experience long-term affects as a result of groundwater*** ~~be affected by~~ drawdown. The riparian corridors are associated with Big Sandy Creek, Little Sandy Creek, Burlson Creek, Middle Yegua Creek, and various tributaries to these waters located outside of the permit area. The area of jurisdictional creeks, tributaries, and drainages in the Simsboro aquifer outcrop within the projected 10-foot drawdown zone was estimated to be 11.5 acres, with an additional 56.8 acres of on-channel ponds (Horizon 2002). Gaining reaches of jurisdictional waters of the U.S. also may be affected by drawdown within the Simsboro outcrop. A detailed evaluation of potential impacts to gaining streams is discussed under Surface Water Quantity Impacts in Section 3.2.4.2, Waters of the U.S. Including Wetlands, within the study area are shown in **Figure 3.2-26**.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS). As a result, the effects to waters of the U.S., including wetlands, as a result of water level changes would be the same as described in Section 3.2.5.2 of the Draft EIS.

increases would be minor and would occur only during initial construction activities while sediment and surface water management systems are being installed. During active mining operations and following mine reclamation, the sediment yield to local streams likely would be reduced below pre-mining levels due to implementation of the sediment and surface water control plans for the operation. A long-term reduction in sediment contribution could lead to changes in the channel substrates for adjacent downstream reaches of the receiving streams. This change in sediment contribution is expected to be minor in magnitude and be substantially attenuated beyond the nearest downstream impoundment or tributary confluence on each drainage. ***The potential exists for minor amounts of replaced soil substitute materials with limited acid generating potential (ABA values down to –6) to be placed within recreated stream drainages or other low-lying areas where springs or seeps may develop following mining. Such occurrences are expected to be rare and very limited in extent. Thus, any resultant contributions to acid generation would be very localized and have a very minor contribution to downstream water quality.*** No other impacts to water quality for waters of the U.S. are anticipated.

No Action Alternative

Under the No Action Alternative, the Three Oaks Mine would not be developed. As a result, impacts to quantity and quality of jurisdictional waters of the U.S. and wetlands resulting from the proposed Three Oaks Mine as described above would not occur. The existing features, flow regimes, and water quality characteristics would remain in their existing conditions. Annual and seasonal changes in water level, flow, and water quality characteristics would continue as they have in the past.

Alternative Mine Plan

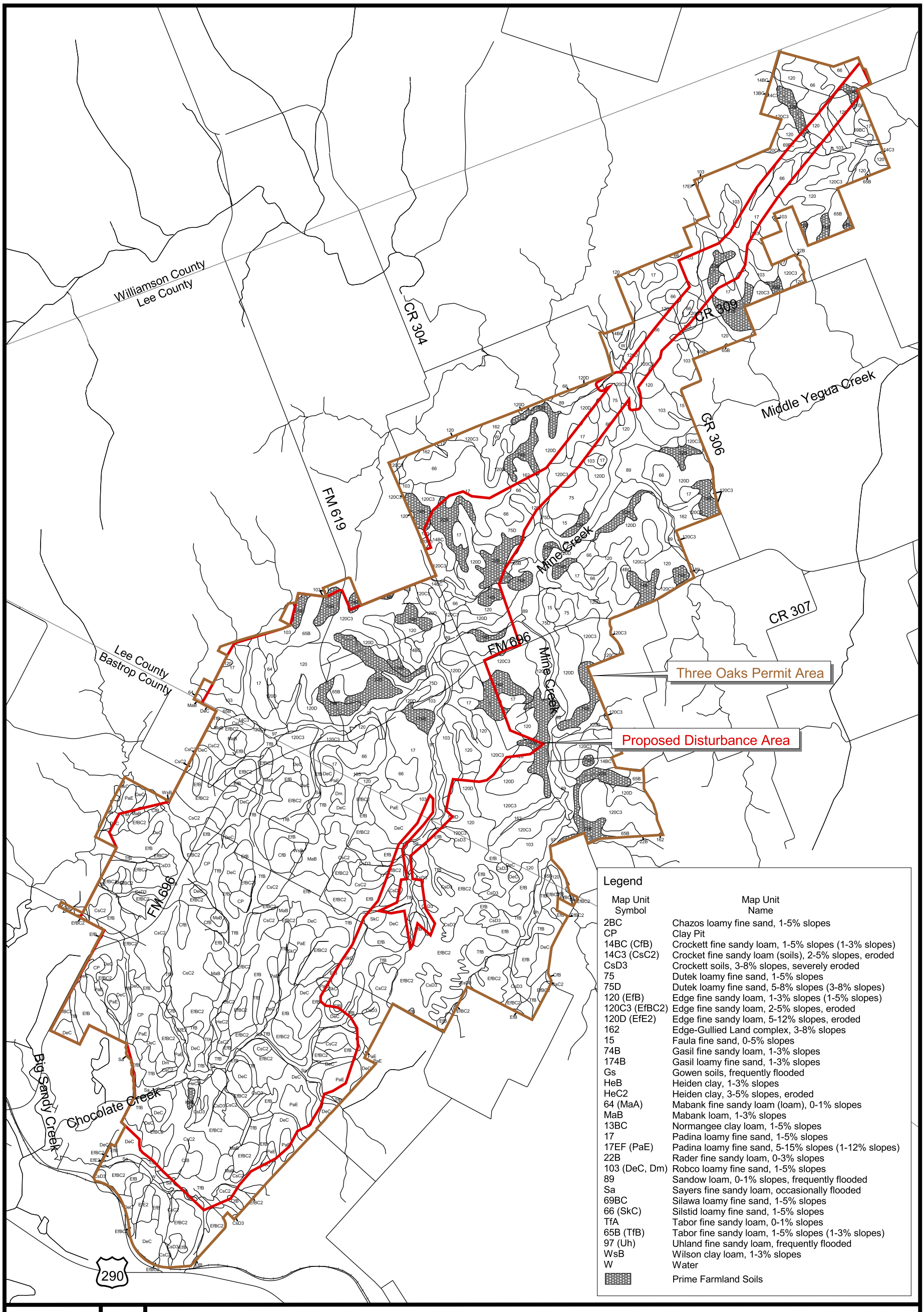
Under the Alternative Mine Plan, potential mine-related impacts to waters of the U.S., including wetlands, would be the same as described for the Proposed Action (see Section 3.4.5.2 of the Draft EIS).

3.2.5.3 Cumulative Impacts to Waters of the U.S. Including Wetlands

Three Oaks without SAWS

Physical Disturbance, Removal, and Replacement of Waters of the U.S. Including Wetlands. The existing Sandow Mine has affected waters of the U.S., including wetlands, as a result of mine development and construction of ancillary facilities. The Sandow Mine will affect approximately 60.6 acres of wetlands and 117.8 acres of other waters of the U.S. prior to mine closure and final reclamation. Reclamation at the Sandow Mine will include the construction of 108.6 acres of wetlands and 131.1 acres of other waters of the U.S. As a result of the reclamation activities, a net increase of 48 acres of wetlands will be created relative to pre-mining conditions. Additionally, a total of 772 acres of developed water features (i.e., ponds and end lakes) will be created as a result of reclamation activities.

Data describing wetland impacts related to the Rockdale power generating station and aluminum smelter, clay mining operations, and Powell Bend Mine were not readily available for review; therefore, it is not possible to quantify impacts to waters of the U.S., including wetlands, associated with these facilities. However, the Rockdale power generating station is located adjacent to Alcoa Lake, and the Lost Pines 1



Legend

Map Unit Symbol	Map Unit Name
2BC	Chazos loamy fine sand, 1-5% slopes
CP	Clay Pit
14BC (CfB)	Crockett fine sandy loam, 1-5% slopes (1-3% slopes)
14C3 (CsC2)	Crocket fine sandy loam (soils), 2-5% slopes, eroded
CsD3	Crockett soils, 3-8% slopes, severely eroded
75	Dutek loamy fine sand, 1-5% slopes
75D	Dutek loamy fine sand, 5-8% slopes (3-8% slopes)
120 (EfB)	Edge fine sandy loam, 1-3% slopes (1-5% slopes)
120C3 (EfBC2)	Edge fine sandy loam, 2-5% slopes, eroded
120D (EfE2)	Edge fine sandy loam, 5-12% slopes, eroded
162	Edge-Gullied Land complex, 3-8% slopes
15	Faula fine sand, 0-5% slopes
74B	Gasil fine sandy loam, 1-3% slopes
174B	Gasil loamy fine sand, 1-3% slopes
Gs	Gowen soils, frequently flooded
HeB	Heiden clay, 1-3% slopes
HeC2	Heiden clay, 3-5% slopes, eroded
64 (MaA)	Mabank fine sandy loam (loam), 0-1% slopes
MaB	Mabank loam, 1-3% slopes
13BC	Normangee clay loam, 1-5% slopes
17	Padina loamy fine sand, 1-5% slopes
17EF (PaE)	Padina loamy fine sand, 5-15% slopes (1-12% slopes)
22B	Rader fine sandy loam, 0-3% slopes
103 (DeC, Dm)	Robco loamy fine sand, 1-5% slopes
89	Sandow loam, 0-1% slopes, frequently flooded
Sa	Sayers fine sandy loam, occasionally flooded
69BC	Silawa loamy fine sand, 1-5% slopes
66 (SkC)	Silstid loamy fine sand, 1-5% slopes
TfA	Tabor fine sandy loam, 0-1% slopes
65B (TfB)	Tabor fine sandy loam, 1-5% slopes (1-3% slopes)
97 (Uh)	Uhland fine sandy loam, frequently flooded
WsB	Wilson clay loam, 1-3% slopes
W	Water
	Prime Farmland Soils

Three Oaks Mine

Figure 3.3-1

Soils and Prime Farmland Soils

Notes:

Map unit symbol and percent slope in parenthesis represent Bastrop County soils.

Many of the prime farmland soils shown do not meet the historic use criteria required for designation of prime farmland.

Source: Alcoa 2000 (Volume 6).

Figure revision: Revised disturbance area for transportation and utility corridor crossing of Middle Yegua Creek.

N

0 2000 4000 Feet

2/26/03

Table 3.3-2
Characteristics of Soils in the Permit Area

Soil Mapping Unit	Mapping Unit Name	pH Range (standard units)	Erosion Potential	Permeability	Runoff Potential	Range of Slope (%)	Prime Farmland
Lee County							
2BC	Chazos loamy fine sand	5.6-7.3	Moderate	Slow	Moderately high	1-5	Yes
14BC	Crockett fine sandy loam	5.6-7.8	Severe	Very slow	High	1-5	No
14C3	Crockett fine sandy loam (sands)	5.6-7.8	Severe	Very slow	High	2-5	No
75	Dutek loamy fine sand	5.6-7.3	Moderate	Moderate	Low	1-5	No
75D	Dutek loamy fine sand	5.6-7.3	Moderate	Moderate	Low	5-8	No
120C3	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	2-5	No
120	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	1-3	No
120D	Edge fine sandy loam	4.5-7.3	Severe	Slow	High	5-12	No
162	Edge-Gullied land complex	4.5-7.3	Severe	Slow	High	3-8	No
15	Faula fine sand	5.1-7.3	Severe	Rapid	Low	0-5	No
74B	Gasil fine sandy loam	6.1-7.8	Moderate	Moderate	Moderately low	1-3	Yes
174B	Gasil loamy fine sand	6.1-7.8	Moderate	Moderate	Moderately low	1-3	Yes
64	Mabank fine sandy loam	5.6-7.3	Moderate	Very slow	High	1-3 (0-1)	No
13BC	Normangee clay loam	5.6-7.3	Severe	Very slow	High	1-5	No
17	Padina loamy fine sand	5.6-7.3	Moderate	Moderate	Moderately low	1-5 (1-8)	No
17EF	Padina loamy fine sand	5.6-7.3	Severe	Moderate	Moderately low	5-15 (8-20)	No
22B	Rader fine sandy loam	4.5-6.5	Moderate	Very slow	High	1-5	Yes
103	Robco loamy fine sand	5.1-6.5	Moderate	Slow	Moderately high	1-5	No
89	Sandow loam	***4.0 to 6.7***	None to slight erosion; frequently flooded	Moderately slow	Moderately high	0-1	No
69BC	Silawa loamy fine sand	4.5-6.5	Moderate	Moderate	Moderately low	1-5	No
66	Silstid loamy fine sand	5.6-7.3	Moderate	Moderate	Low	1-5	No
65B	Tabor fine sandy loam	5.1-6.5	Moderate	Very slow	High	1-5	No

Table 3.3-8
Prime Farmlands within the Anticipated Disturbance Area

Soil Mapping Unit	Soil Mapping Unit Name	Prime Farmlands within the Disturbance Area (acres)[1]	Percent of Disturbance Area
2BC	Chazos	0	0
74B	Gasil	5.2	0.06
174B	Gasil	30.0	0.35
HeB	Heiden	0	0
22B	Rader	21.0	0.24
Total		**56.2**	**0.65**

[1]These acres are defined by RRC regulations.

Sources: Alcoa 2001c (Volume 3).

Salvage, stockpiling (if necessary), and replacement would be conducted in accordance with RRC regulations (TAC 2001e). Soil amendments would be applied, if necessary, as determined by a testing program. As part of reclamation monitoring, crops would be monitored to compare the reclaimed soil productivity with nearby undisturbed prime farmland areas. Prime farmland restoration would be deemed successful when the productivity of the reclaimed areas is equal to or greater than that of non-mined prime farmland in adjacent areas (see Section 2.5.3.9, Monitoring of the Reclaimed Site).

Native soil characteristics (see **Table 3.3-3**) have been compared to RRC suitability guidelines and to the characteristics of other potential growth media sources (e.g., overburden). The suggested RRC guidelines for general use in Texas are presented in **Table 3.3-9**. The primary limitations to using the native topsoil materials in reclamation are their sandy texture, highly erodible nature from the actions of both wind and water, and low fertility and moisture-holding capacity. The primary limitations to using the subsoil materials in reclamation are their heavy clay texture (with related structural, crusting and compaction, and permeability limitations) and frequent occurrence of strong acidity.

To promote site stabilization and revegetation success in the mine area, for areas other than prime farmlands, Alcoa proposes to select suitable growth media substitutes from ***both soil and*** overburden materials ***that would be*** encountered ***and mixed*** during the mining process. These materials are proposed for use in place of native soil materials on the basis that they have ***comparable or*** better suitability for successful restoration of productive post-mining land uses. Intensive investigations of the native soil materials were carried out during baseline investigations~~,~~ ~~and~~ ***Used alone*** they are deemed to be less suitable for reclamation purposes than other materials that can be obtained from the site (Alcoa 2000 [Volume 9]). ***It is expected that the selective handling and blending of suitable overburden strata would result in overall improvement of the reclamation growth media. A detailed review of the selective handling performance and testing program has been conducted by the RRC. The agency has approved the program, which is discussed on pages 2-43 and 2-43a of the Final EIS. RRC-approved post-mine soil performance standards are presented in Table 2-10a on page 2-43b of the Final EIS.***

To determine the feasibility of the selective handling approach, ~~24~~ core samples ***from 24 boreholes*** were analyzed for suitability as growth media, generally using the parameters shown in **Table 3.3-9**. Samples

Table 3.3-9
General Suitability Criteria for Topsoil Used in Reclamation

Suitability Parameter	RRC Recommended Criteria
pH (standard units)	≥ 5.0 to ≤ 8.4
ABA or NNP (tons/kiloton)	≥ 0
Sand (percent of fraction 0.05 to 2 mm diameter)	≤ 80
Clay (percent of fraction < 0.002 mm diameter)	≤ 40
Electrical conductivity (mmhos/cm)	≤ 4.0
Sodium adsorption ratio (SAR)	< 13
Boron (ppm)	≤ 5
Cadmium (ppm)	≤ 0.7
Molybdenum (ppm)	≤ 5
Selenium (ppm)	≤ 2

Note: mm = millimeter.
mmhos/cm = millimhos/centimeter.
ppm = parts per million.
ABA = acid base accounting.
NNP = net neutralization potential.

Sources: RRC 1988; Alcoa 2000 (Volume 9); Hodgkiss 2001.

The thickness of suitable growth media varies widely between borehole locations and with depth. In 4 of the 24 boreholes, the thickness of suitable material was 10 feet or less based on RRC-***recommended*** criteria. Two of the boreholes have no suitable material if RRC-***recommended*** criteria are rigorously applied. One borehole has approximately 16 feet of suitable material, 5 boreholes have suitable materials 20 to 40 feet thick, and the remaining 14 boreholes have suitable materials occurring in zones 40 to 80 feet thick or more. Similar to the native soil conditions, the limiting factors that would exclude other overburden and interburden materials from use in reclamation are dominantly related to texture (strongly sandy or clayey grain sizes). In some cases, trace metals (mostly selenium) and salt accumulations (as indicated by higher electrical conductivity and/or sodium adsorption ratio) restrict the suitability of materials. Acid-base conditions and net neutralization potential also are limiting in some zones.

Alcoa's investigation indicated that***, based on the RRC-recommended criteria as presented in Table 2-10a,*** very large volumes of suitable alternative growth media from overburden and interburden sources exist within the proposed mine area. This was confirmed by further inspection during this impact assessment. The volume of suitable growth media is sufficient to replace a 4-foot depth of cover on the disturbed mine area. This assumes careful implementation of the selective handling program (see Section 2.5.2.6). ***Additional verification with RRC has been conducted with respect to overburden acid neutralization data for Three Oaks and the reclamation conditions at the Sandow Mine. This review indicates that the proposed selective handling program can be implemented to achieve successful restoration of a suitable recontoured surface. However, the physical and chemical selection criteria actually proposed for use in recovering suitable overburden and interburden at the proposed Three Oaks Mine are not clearly defined in Alcoa's RRC permit application or its supplements. To minimize potential surface runoff water quality effects and related potential short-term and long-term effects on drainages, additional mitigation would be implemented as identified in measure S-1 in Table 2-15***

of the Final EIS. The use of draglines and/or truck/shovel fleets during mining operations would promote the mixing of selected ***growth media*** materials and allow for retrieval and inclusion of some less-suitable materials if they are encountered. Mixing of the selected growth media is anticipated to be more thoroughly accomplished under the proposed pit operations approach than it would be under a scraper/bulldozer operation, if the latter were used to salvage native topsoils.

The use of ~~more~~ suitable growth media from ~~overburden and interburden~~ ***mixed on-site*** sources, as opposed to ~~the~~ ***salvaging*** native topsoil materials, is not anticipated to limit the success of the reclamation program and ~~possibly may~~ ***probably would*** enhance it. The reconstructed growth media is anticipated to have post-mine soil textures with an improved

balance of sand, silt, and clay, and is not expected to display the adverse physical characteristics of the native topsoil (i.e., excessive sand or clay). In addition, the pH and acid/base relationship in the alternative growth media is anticipated to be ~~more advantageous to crop growth~~ ***comparable to or better*** than the native topsoil characteristics. To ensure reclamation success, growth media testing would occur after the growth media is applied to the recontoured surface as part of the reclamation program described in Section 2.5.3, Closure and Reclamation. Based on reclamation procedures practiced at the existing Sandow Mine, it is anticipated that successful site stabilization and restoration of productive post-mining land uses would occur at the Three Oaks Mine as required by RRC regulations.

If the current litigation involving the jointly owned parcel in the southern end of the transportation/utility corridor is not resolved in a manner that would enable Alcoa to construct these facilities as proposed, some realignment of this corridor could be required. This adjustment could result in minor changes to the prime farmland soils disturbance acreage identified in Table 3.3-8 of the Draft EIS. However, based on the commitment for salvage and reapplication of prime farmland soils, the overall effects to these soils would be the same as described in Section 3.3.2.1 of the Draft EIS.

Water Discharge

Based on the planned implementation of erosion control measures (e.g., sediment control ponds, diversion ditches, silt fences, straw bales, and revegetation measures), the potential for soil erosion as a result of surface water discharge is anticipated to be low. No indirect impacts to soils on prime farmland would occur as a result of water discharge.

3.3.2.2 No Action Alternative

The mine-related disturbance of 8,654 acres of soils would not occur under the No Action Alternative. As a result, the direct and indirect impacts as described for the Proposed Action would not occur under this alternative.

3.3.2.3 Alternative Mine Plan

Under the Alternative Mine Plan, potential mine-related impacts to soils as a result of surface disturbance and water discharge would be the same as described for the Proposed Action (see Section 3.3.2.1 of the Draft EIS).

3.3.3 Cumulative Impacts

Past, present, and reasonably foreseeable future projects within the cumulative effects area that have resulted and will result in the removal and disturbance of native soils include the Sandow Mine, Rockdale power generating station and aluminum smelter, clay mining and brick manufacturing near Butler and Elgin, Powell Bend Mine, and Lost Pine 1 and Sim Gideon power generating stations, and any future residential and commercial development.

development. Approximately 291 acres of native soils have been disturbed as a result of mine construction and operation at the Powell Bend Mine. This mine is being reclaimed under RRC regulations. In addition, approximately 900 acres of native soils have been permanently lost in association with the development of Lake Bastrop at the Lost Pines 1 and Sim Gideon power generating stations.

The continued growth of clay mining and manufacturing operations are reasonably foreseeable future actions that may occur within the cumulative effects area; however, surface disturbance for these actions cannot be determined at this time. Based on the quantifiable disturbances, including the soils loss associated with the Three Oaks Mine, a total of 27,218 acres of soils would be removed or disturbed within the cumulative effects area, of which a maximum of 23,132 acres have been or would be revegetated and the remainder reclaimed as water features. Based on a combined ~~188~~ ***195*** acres of previously existing water features within these existing and proposed disturbance areas, there would be a cumulative loss of approximately ~~3,~~ ~~274~~ ***3,267*** acres of native soils as a result of conversion of these lands to water features.

3.3.4 Monitoring and Mitigation Measures

Alcoa has committed to conducting soil sampling in the mine area to ensure that a suitable growth media is present for revegetation. Any areas that are deemed as unsuitable material would be covered with a suitable material to the appropriate depth (see Section 2.5.3.1, Rough and Final Grading). ~~No additional monitoring or mitigation is being considered for soils.~~ ***The USACE has identified the following additional mitigation for soils.***

S-1: Monitoring/Mitigation of Selectively Handled Overburden Relative to Localized Aquatic Resource Protection. In addition to the proposed sampling, analysis, and treatment procedures for reclaimed soil surface characteristics as outlined in Alcoa's RRC permit (see performance criteria listed in Table 2-10a on page 2-43b of the Final EIS), Alcoa would implement the following monitoring and treatment procedures relative to recreated drainage courses.

Within 500 feet on both sides of reconstructed drainage courses potentially subject to saturation or shallow water table conditions following spoil recharge (defined herein as areas at or below an elevation of 490 feet NGVD), Alcoa would conduct a supplemental sampling and analysis program for acid base accounting (ABA) and pH. This sampling would be conducted at approximately the same intensity as the sampling conducted for Alcoa's RRC permit (approximately one sample per 5.7 acres); however, discrete samples would be collected at each sampling site for the 0- to 1-foot layer and the 1- to 4-foot layer. Samples would not be composited over multiple sites. These additional samples would be analyzed for ABA and pH. Sites within the upper 4 feet of selectively handled material that yield ABA values of –5 or lower or pH values of 4.0 or lower would be mitigated by in-situ treatment or removal of the unsuitable material and replacement with suitable material.

3.3.5 Residual Adverse Effects

Residual adverse effects resulting from the Three Oaks Mine would include the permanent net loss of approximately ~~825~~ *817* acres of native soils, resulting from the conversion of these lands to water features (i.e., ponds and end lakes) in conformance with the RRC approved post-mining land uses.

Williamson County
Lee County
CR 304
CR 309
Middle Yegua Creek
CR 306
FM 619
Mine Creek
CR 307
Lee County
Bastrop County
FM 696
Mine Creek
Proposed Disturbance Area
Three Oaks Permit Area
FM 696
Big Sandy Creek
Chocolate Creek
290
McDade

Three Oaks Mine

Figure 3.4-1

Vegetation Types Present within the Permit Area

Legend

- Aquatic Habitat
- Grassland
- Mesquite Grassland
- Riparian Woodland
- Upland Woodland

Source: Alcoa 2000 (Volume 6).

Figure revision: Revised disturbance area for transportation and utility corridor crossing of Middle Yegua Creek.

N

0 2000 4000 Feet

1/28/03

Sandhill Woollywhite (*Hymenopappus carrizoanus*)

This species is listed as rare by the TPWD. The sandhill woollywhite occurs in deep sands typically derived from the Carrizo and similar formations, in disturbed areas, open areas in grasslands, and oak or pine woodlands (Turner 1989; TXBCDS 2001). This species in known from ten Texas counties, including Bastrop County (Texas A&M Bioinformatics Working Group 2002b; TXBCDS 2002). In Bastrop County, this species has been observed south of the Colorado River approximately 24.6 miles south of the study and cumulative effects areas. The soil requirements for this species are generally lacking in the permit area. Based on the habitat requirements of this upland species, the sandhill woollywhite has been eliminated from further analysis.

3.4.1.4 Weeds and Invasive Species

Populations of invasive plant species may occur in the proposed permit area; field surveys have not been conducted to determine the locations and areal extent of any potentially existing populations. The State of Texas does not have a designated noxious weed or invasive plant species list (Alderson 2001). However, the Texas Department of Agriculture (TDA) has prohibitions and restrictions on noxious weed seeds. Information regarding prohibited (species not allowed in seed mix) and restricted (species inclusion in seed mix is limited) noxious weed seeds is provided in Sections 9.1 and 9.9 (i.e., Noxious Weed Seed) of the TAC, Title 4, Part 1, Chapter 9, Subchapter E, Rule 9.9 and the Texas Register: 22 Tex Reg 128 dated January 7, 1997 (TAC 1997). Prohibited and restricted noxious weed seeds are listed in **Table 3.4-1**.

The TPWD maintains a list of harmful or potentially harmful exotic aquatic plant species that cannot be used without a permit and that should be controlled if they occur within the project area (TAC 1997a). Table 3.4-1a lists these plants as stated in TAC, Title 31, Part 2, Chapter 57, Subchapter A, Rule 57.111.

3.4.2 Environmental Consequences

3.4.2.1 Proposed Action

General Vegetation

Surface Disturbance. Under the Proposed Action, a total of 8,654 acres of vegetation would be directly affected as a result of surface disturbance within the mine area, along the transportation and utility corridor, within the ancillary support facilities areas, and along the relocated road and utility corridors. As discussed in Section 2.5.2.3, Clearing and Grubbing, trees and other vegetation would be removed incrementally in advance of mine development over the 25-year life of the mine. **Table 3.4-2** identifies the acreages of specific vegetation types that would be disturbed or removed as a result of the proposed project. As shown, the majority (approximately 81 percent) of the disturbance would occur in grassland and upland woodland areas.

Short-term (limited to the life of the mine and reclamation) and long-term (extending beyond the life of the mine and reclamation) impacts to vegetation would occur as a result of project construction and operation. Short-term impacts would result from the removal of herbaceous and woody (i.e., trees and shrubs) species

Table 3.4-1a
Harmful or Potentially Harmful Exotic Aquatic Plants

Common Name	*Scientific Name*
Alligatorweed	***Alternanthera philoxeroides***
Common waterhyacinth	***Eichhornia crassipes***
Waterhyacinth	***Eichornia azurea***
Water-thyme	***Hydrilla verticillata***
Water spinach	***Ipomoea aquatic***
Lagarosiphon	***Lagarosiphon major***
Punktree	***Melaleuca quinquenervia***
Eurasian watermilfoil	***Myriophyllum spicatum***
Torpedograss	***Panicum repens***
Waterlettuce	***Pistia stratiotes***
Water-moss	***Salvinia* spp.**
Dotted duckmeat	***Spirodela oligorhiza***

Source: TAC 1997b.

Table 3.4-2
Acreages of Affected Vegetation

Vegetation Type[1]	Disturbance Acreage[2]
Grassland	3,626
Upland woodland	3,349
Mesquite grassland	1,245
Riparian woodland	352
Aquatic	82
Total Area	**8,654**

[1]These categories include minor areas of existing disturbance such as residences and roadways and approximately 6 acres of mesquite grassland outside of the RRC permit area that would be affected by road improvements and widening of CR 89. These areas are not shown in Figure 3.4-1.
[2]Acreage within anticipated disturbance area as shown in **Figure 3.4-1**.

Source: Alcoa 2000 (Volume 5).

(USFS 2001). To minimize these impacts, disturbance areas would be reclaimed as discussed in Section 2.5.3.5, Revegetation. In addition, reclamation of the mine area would proceed concurrently with mining operations as pit areas are backfilled. Ancillary facility areas would be reclaimed following the completion of mining.

Indirect impacts to native vegetation that likely would occur as a result of the Proposed Action include: 1) increased potential for encroachment of invasive plant species and 2) economic impacts to commercially harvestable vegetation, including trees and herbaceous vegetation, which provide firewood and forage for livestock grazing. Disturbance areas would be prone to the establishment of invasive plants from adjacent, undisturbed areas. Successful reclamation would minimize the encroachment of invasive species into reclaimed areas. The encroachment of invasive species could be further minimized through implementation of a control program in coordination with the NRCS (see mitigation measure V-1 in Section 3.4.4, Monitoring and Mitigation). The loss of commercially harvestable herbaceous vegetation would be minimal since

reclaimed areas would provide forage for livestock and wildlife several years after reclamation. The salvage of trees removed during construction is infeasible due to safety and liability concerns that would outweigh the benefits of utilizing this resource. This loss would be minimized through the planting of trees in the disturbance area; however, any commercial value would not be realized for a number of years.

The selective handling plan proposed by Alcoa for creating a suitable growth medium in reclaimed areas is expected to prevent any widespread occurrence of adverse soil characteristics in the reclaimed area. The RRC suitability criteria included in the mine permit (see Table 2-10a) should help ensure successful revegetation. The range of allowable characteristics is generally conducive to achieving the stated revegetation goals. However, if small pockets of materials with the highest acid generating potential allowable under these criteria (ABA values down to –6) were to occur in recreated stream drainages or low-lying areas where springs or seeps may develop following mine completion, localized acidic conditions could develop with the potential to adversely affect wetland or riparian vegetation being reestablished in these local areas.

The disturbance areas would be reclaimed to achieve the post-mine land uses as required by RRC and discussed in Section 2.5.3, Closure and Reclamation. Although the land use categories would not be directly comparable to the vegetation communities described in Section 3.4.1, it is evident that some comparisons are warranted. For example: 1) the area occupied by surface water is expected to increase more than tenfold from approximately ~~70~~ ***77*** acres to approximately 895 acres; 2) the area occupied by riparian habitat would increase from approximately 350 acres to approximately 379 acres; 3) residential areas would decrease from several residences before mining to a single residence after mining; and 4) land uses, such as cropland and industrial/commercial (roadways and utility rights-of-way), are expected to occupy relatively similar areas before and after mining. In addition to the reclamation of the disturbance area, Alcoa has developed a ~~draft~~ Mitigation Plan (***see*** Appendix E ***of the Final EIS***), which would provide for the offsite enhancement of

approximately 44.2 acres of riparian vegetation in the Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site*** (see **Figure 2-12** and **Table 2-14**).

If the four uncontrolled parcels in the eastern and southern portions of the proposed disturbance area cannot be obtained by Alcoa, the modification in the disturbance area to accommodate these parcels, as described on page 2-21 of the Final EIS, would result in changes in the proportion of disturbance acreages identified for grassland, upland woodland, and riparian woodland vegetation types (see Table 3.4-2 of the Draft EIS). This change would include a minor reduction in the riparian woodland disturbance area. However, the overall effects to vegetation would be the same as described in Section 3.4.2.1 of the Draft EIS.

Mine Area. Mine development and operation would remove a total of 6,466 acres of vegetation as indicated in **Table 2-5** and shown in **Figure 3.4-1**. The incremental loss of vegetation would occur by mine block over a 25-year period. Concurrent reclamation, including the installation of ponds, would occur after each mine block has been backfilled. The last pits to be mined would not be backfilled and revegetated but would be reclaimed as end lakes. In addition, smaller impoundments would be distributed throughout the reclaimed mine area. As a result, there would be a permanent net loss of approximately ~~825~~ ***817*** acres of vegetation due to conversion to pond and end lake post-mining land uses.

Based on the spatial disturbance of existing versus proposed ponds, the increase in the number of ponds following reclamation, and the reclamation of at least some of the existing ponds in accordance with post-mining land uses, it is not possible to accurately quantify the permanent loss of vegetation by vegetation type in association with the net increase in pond surfaces. However, the creation of end lakes, which would comprise the majority of the net loss of vegetation, would result in the permanent loss of 722 acres of vegetation. Of this 722 total acres, the vegetation permanently lost would include approximately 322 acres of upland vegetation, 233 acres of grassland, 155 acres of mesquite vegetation, 6 acres of aquatic vegetation, and 6 acres of riparian vegetation.

As described above, there would be minor changes in the disturbance acreages for grassland, upland woodland, and riparian woodland vegetation types if Alcoa cannot obtain the four uncontrolled parcels in the eastern and southern portions of the mine area.

Ancillary Facilities. A total of 1,624 acres of vegetation would be disturbed as a result of construction of the ancillary support facilities. Surface disturbance associated with ancillary facilities would occur during the first and second years of mine construction (see **Table 2-5**). Ancillary support facilities include office building, warehouses, shops, storage areas, parking, and access roads (see Section 2.5.1.7, Ancillary Support Facilities, and **Figure 2-3**). These areas would be reclaimed following the completion of mining.

Three Oaks-to-Sandow Transportation and Utility Corridor. Construction of the transportation and utility corridor would result in the disturbance of 359 acres of vegetation during the first and second years of mine construction. Reclamation of the transportation and utility corridor would occur following the completion of mining.

As described on page 2-21 of the final EIS, if current litigation involving the jointly owned parcel is not resolved in a manner that would enable Alcoa to construct this facility as proposed, some realignment of the corridor could be required. This adjustment could result in minor changes to the acreages of various vegetation types that would be disturbed by construction, as identified in Table 3.4-2 of the Draft EIS. The overall effect of such changes, if necessary, is expected to be minor and likely would affect only the grassland, mesquite grassland, and upland woodland categories.

Road and Utility Relocation. Relocated road and utility corridors, as identified in Section 2.5, Proposed Action, would disturb a total of 205 acres of vegetation, primarily during the first and second years of mine construction. Although the relocated road segments would result in the permanent loss of vegetation, this impact would be offset in part by the reclamation of the abandoned road segments.

Water Level Change. It is anticipated that groundwater withdrawal from the Simsboro aquifer would not result in direct impacts to upland vegetation within the 10-foot drawdown contour of the Simsboro aquifer outcrop. Oak, pine, and other large tree species, as well as herbaceous plant species, have shallow root systems and predominantly rely on soil moisture from precipitation. Post oaks and loblolly pines have similar rooting depths of 3 to 5 feet, although taproots may grow to 6.5 feet in depth in sandy or loamy soils (USFS 1990). These taproots provide stability for the trees while surface roots are primarily responsible for nutrient and moisture uptake. Since these species are generally unable to access groundwater at depths

greater than 10 feet, it is unlikely that the vegetation would be affected. As discussed in Section 3.2.3.2, mine-related groundwater drawdown in the Calvert Bluff aquifer would be restricted to the lower portion of the aquifer. As a result, no vegetation-related impacts have been identified.

Potential impacts to riparian or wetland vegetation potentially could occur where gaining stream flow is sustained by groundwater sources within the 10-foot drawdown area of the Simsboro outcrop. As discussed in Section 3.2.4.2, a measurable decrease in groundwater baseflow of gaining reaches is not anticipated where the groundwater drawdown is projected to be 10 feet or less; therefore, impacts to the vegetation associated with these reaches are not anticipated. Within the estimated 10- to 20-foot drawdown area, flows associated with gaining stream segments fed by groundwater could potentially decrease, thereby reducing the amount of available water for wetland and riparian vegetation. This reduction in available water may result in the partial loss of herbaceous riparian and wetland vegetation. However, impacts to woody riparian species established along intermittent creeks are not anticipated since these species have more extensive root systems than herbaceous riparian species. In the 20-foot or greater drawdown area, a decrease in groundwater baseflow of gaining reaches fed by groundwater within the Simsboro outcrop area likely would occur, thereby resulting in the potential long-term loss of herbaceous riparian and wetland vegetation and a potential loss of woody riparian species established along the upstream reaches of Big Sandy, Middle Yegua, and Walleye Creeks and sections of Little Sandy and Big Sandy Creeks. These effects likely would be localized as observed along similar reaches of stream affected by the Sandow Mine. Impacts to Big Sandy and Middle Yegua Creeks, as a result of drawdown during the life of mine, would be partially offset by surface water discharge, which would minimize the potential loss of riparian vegetation along the creeks below the discharge point. Section 3.2.4.2, provides detailed information pertaining to the impacts of water level changes on surface waters. As discussed in that section, the Calvert Bluff aquifer does not provide baseflow to any of the streams in the study area.

Water level changes may potentially affect seeps and springs fed by groundwater associated with the Simsboro outcrop (see Section 3.2.4.2). Riparian and wetland vegetation associated with one known spring or seep that occurs within the 20-foot or greater drawdown area would likely ~~be~~ ***experience long-term adverse*** affect~~ed~~***s as a result of groundwater*** ~~by~~ drawdown. One spring or seep occurring in the 10- to 20-foot drawdown area may be affected by drawdown with a minimal loss of riparian or wetland vegetation. Impacts to riparian and wetland vegetation associated with five springs and seeps within the 10-foot or less drawdown area are not anticipated from drawdown activities. No impacts to seeps or springs as a result of Calvert Bluff dewatering drawdown have been identified (see Section 3.2.4.2); as a result, there would be no impacts to associated riparian or wetland vegetation.

Groundwater withdrawal from the Simsboro aquifer would not affect the small, sparse stands of loblolly pines in the Lost Pines area since the Simsboro Formation outcrop does not extend to that area.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS). As a result, the effects to vegetation as a result of water level changes would be the same as described in Section 3.4.2.1 of the Draft EIS.

reaches until the aquifer recovers (approximately 40 years for 90 percent recovery and approximately 100 years for 100 percent recovery). Effects to riparian and wetland vegetation from water discharge would be most prevalent along the stream segments within close proximity to the discharge points; riparian and wetland vegetation would progressively decrease as the distance from the discharge points increases. No impacts to riparian or wetland vegetation are anticipated to result from sedimentation, as the proposed discharge rates are not anticipated to contribute to channel erosion (see Effects of Discharges to Streams in Section 3.2.4.2. The establishment of riparian and wetland vegetation may occur along Chocolate Creek over a 2- to 3-year period as a result of discharge. This vegetation would likely exist for the duration of the discharge period. After the discharge period, riparian and wetland vegetation that had become established during the discharge period would be lost as the baseflow returned to pre-discharge conditions.

Indirect impacts, as a result of water discharge, would include an increased potential for invasive plant species establishment along the stream channels. Mine-related flows in Middle Yegua, Upper Big Sandy, and Chocolate Creeks would provide ample soil moisture during the discharge period that would create a more desirable environment for invasive plant species establishment.

Special Status Species and Species of Special Concern

As discussed in Section 3.4.1.3, the special status species and species of special concern that were identified for the project by the USFWS (2002) and TPWD (2002b) have been eliminated from further analysis based on their known distribution or habitat requirements, which place them outside of the project's area of effect.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in minor changes to dewatering and depressurization pumpage rates (see page 2-21 of the Final EIS) and a related minor change in mine-related discharges to streams (see page 3.2-81a of the Final EIS). However, it is anticipated that the effects to vegetation would be the same as described in Section 3.4.2.1 of the Draft EIS.

3.4.2.2 No Action Alternative

The direct mine-related disturbance of 8,654 acres of vegetation would not occur under the No Action Alternative. In addition, the potential impacts to vegetation associated with mine-related water level changes and surface water discharge would not occur. As a result, the impacts to vegetation as described for the Proposed Action would not occur.

3.4.2.3 Alternative Mine Plan

Under the Alternative Mine Plan, potential mine-related impacts to vegetation, including special status species and species of special concern, as a result of surface disturbance, water level change, and water discharge would be the same as described for the Proposed Action (see Section 3.4.2.1 of the Draft EIS).

approximately 772 acres will be reclaimed as post-mining ponds and end lakes. Based on an estimated pre-mining waters of the U.S. acreage of approximately 118 acres, there will be a net loss of approximately 654 acres of vegetation through conversion to water features. Approximately 100 acres and 275 acres of Post Oak Savannah vegetation have been removed at the Rockdale power generating station and aluminum smelter, respectively, since the 1950s. In addition, approximately 895 acres of vegetation have been converted to form Alcoa Lake in association with development of the Rockdale facilities.

Clay mining and brick manufacturing in the Butler and Elgin area include approximately 1,355 acres in ownership. Operations at these facilities have collectively resulted in the removal of approximately 1,000 acres of vegetation for clay pits and ancillary facilities. Based on limited information received from inquiries to these operations, at least a portion of this disturbance ultimately will be reclaimed (50 percent assumed for this analysis) (see Section 2.6.1.4). Approximately 291 acres of Post Oak Savannah vegetation have been removed as a result of mine construction and operation at the Powell Bend Mine. The Powell Bend Mine is currently being reclaimed in accordance with RRC regulations. In addition, approximately 900 acres of vegetation have been converted to form Lake Bastrop in association with operation of the Lost Pines 1 and Sim Gideon power generating stations.

The continued growth of clay mining and manufacturing operations and expansions by the various brick manufacturing companies are the only reasonably foreseeable future actions that may occur within the cumulative effects area. However, surface disturbance for these actions cannot be determined at this time.

Based on the quantifiable disturbances, including disturbances associated with the Three Oaks Mine, a total of 27,218 acres of vegetation would be removed or disturbed within the cumulative effects area of which a maximum of 23,132 acres would be revegetated, with the remainder reclaimed as water features. Based on a combined ~~188~~ ***195*** acres of previously existing water features within these existing and proposed disturbance areas, there would be a cumulative loss of approximately ~~3,274~~ ***3,267*** acres of vegetation as a result of the conversion of lands to water features.

As discussed in Section 3.4.2.1, the Proposed Action would not affect loblolly pines, including the Lost Pines Region of Texas, based on the location of loblolly pine stands in relation to the proposed mine and the species' shallow rooting system. As a result, the proposed Three Oaks Mine would not contribute to any cumulative impacts to this species.

As discussed in Section 3.2.4.2, cessation of Sandow Mine dewatering and depressurization discharges would end artificial flow in East Yegua and Walleye Creeks in approximately 2003, thus returning the creeks to their original ephemeral or intermittent regime. As a result, a progressive reduction in the extent of riparian vegetation along these channels may occur approximately 10 to 15 miles downstream of the discharge points. However, water discharge from the Three Oaks Mine would augment flows in Big Sandy, Middle Yegua, and Chocolate Creeks approximately 4 to 6 miles downstream of the discharge points. These augmented flows would result in the establishment of riparian vegetation due to increased available water, thereby temporarily (through approximately year 2030) offsetting the progressive loss of riparian vegetation resulting from the cessation of discharges from the Sandow Mine. Following year 2030, some loss of established vegetation along Big Sandy, Middle Yegua, and Chocolate Creeks also may occur.

sites for this species. As a result, it is possible that individuals could utilize suitable roost sites (e.g., man-made structures) and foraging habitat within the study area and cumulative effects area.

Plains Spotted Skunk (*Spilogale putorius interrupta*). This skunk is a USFWS species of concern and a TPWD rare species. Distributed throughout much of eastern and northern Texas, this species typically occupies wooded areas and tall-grass prairies with rock outcrops but may occupy short-grass prairies to a lesser extent (Davis and Schmidly 1994). This species has been documented as occurring in Bastrop County (Davis and Schmidly 1994). As a result, it is possible that individuals could utilize potentially suitable habitat within the study area (including the permit area) and the cumulative effects area.

Environmental Consequences

3.5.2.1 Proposed Action

Terrestrial Wildlife

The potential impacts of the proposed Three Oaks Mine on terrestrial wildlife can be classified as short-term and long-term. Short-term impacts arise from habitat removal and disturbance as well as from activities associated with the mine operation; these impacts would cease upon mine closure and completion of successful reclamation. Long-term impacts consist of permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. Direct impacts to wildlife populations would include limited direct mortalities from mine development, habitat loss or alteration, incremental habitat fragmentation, and animal displacement. Indirect impacts would include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

Surface Disturbance. The greatest impact to wildlife from surface disturbance would be the temporary and permanent loss or alteration of habitat. Temporary and permanent loss or alteration of habitats would be caused by construction and operation of the mine and its associated facilities. Habitat loss or alteration would result in direct losses of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. Displacement also could result in some local reductions in wildlife populations if adjacent habitats are at carrying capacity.

As discussed in Section 3.4, Vegetation, the Proposed Action would result in the direct loss of approximately 8,654 acres of vegetation and aquatic resources (see **Table 3.4-2**). In the mine area, a related direct loss of habitat would occur incrementally over the 25-year life of the mine, with approximately 640 acres of mine disturbance at any given time. The disturbance area would be reclaimed to achieve specified post-mining land uses, including fish and wildlife habitat, as required by RRC and discussed in Section 2.5.3, Closure and Reclamation. Of the total disturbance, approximately 4,520 acres would be reclaimed to wildlife habitat; 895 acres of aquatic habitat (a net increase of approximately ~~825~~ ***817*** acres) would be provided by development of water features (i.e., ponds and end lakes); and 4,010 acres would be reclaimed to other post-mining land uses (i.e., pastureland, cropland, developed water sources, and undeveloped lands) that also would provide habitat for specific wildlife species. In addition, approximately 379 acres of riparian habitat would be developed along some of the restored channels counted within the above categories. As a

addition to the offsite enhancement of approximately 20.6 acres of riparian habitat in the Middle Yegua Mitigation Site (see **Figure 2-12** and **Table 2-14**). The direct loss of habitat would be a short-term impact in much of the mine area because vegetation would become re-established following project reclamation, which would be conducted concurrently with mining. Facilities that would be in place throughout the life of the project (e.g., offices, mine maintenance, crusher/stockpile facility, transportation and utility corridor) would result in a long-term impact to habitats until closure and final reclamation have been completed. Approximately ~~123~~ ***124*** acres would be reclaimed for industrial/commercial (e.g., roads) and residential purposes. The area occupied by these uses would be relatively similar before and after mining. However, some long-term adverse (and beneficial) impacts would result where the habitat is different than it was before mining. Acreages of disturbance by mine-year and mine component are presented in **Table 2-5**.

If the four uncontrolled parcels in the eastern and southern portions of the proposed mine disturbance area and the one uncontrolled property at the southern end of the transportation/utility corridor cannot be obtained by Alcoa, the modification in the disturbance area to accommodate these parcels, as described on page 2-21 of the Final EIS, would result in minor changes in the proportion of disturbance acreages identified for grassland, mesquite grassland, upland woodland, and riparian woodland habitats (see page 3.4-11 of the Final EIS). However, the overall effects to terrestrial wildlife species would be the same as described in Section 3.5.2.1 of the Draft EIS.

Game Species. Potential direct impacts to big game species (i.e., white-tailed deer) would include the incremental short-term reduction of potential forage and the incremental increase of habitat fragmentation from construction and development activities (i.e., vegetation removal for mine area development, ancillary facilities, transportation and utility corridor, and road and utility relocations). This anticipated loss of habitat would result in a small, incremental reduction in the amount of available habitat and is expected to have little impact on the existing low deer population densities that occur in the study area (see Section 3.5.1.2). No important big game corridors or key seasonal habitats have been identified within the study area. Therefore, impacts to deer populations are expected to be low.

Direct impacts to small game species from surface disturbance would include the incremental short-term loss of potentially suitable breeding, nesting, and foraging habitat in upland and riparian areas; in most instances, suitable habitat adjacent to the project areas would be available for use by these species. However, as discussed above, displacement would increase competition and could result in some local reductions in wildlife populations if adjacent habitats are at carrying capacity. This displacement would be temporary and short-term until vegetation is re-established following project reclamation. Potential direct adverse impacts also could include nest or burrow abandonment or loss of eggs or young. These losses would reduce productivity for that breeding season.

Nongame Species. As indicated in Section 3.5.1.3, a variety of resident and migratory bird species (e.g., raptors, songbirds, waterfowl) have been identified as potentially occurring in the study area. Although no nest sites were identified during the wildlife surveys within the permit area, it is possible that nesting birds could be present within or adjacent to construction or development areas associated with the Proposed Action. Potential direct adverse impacts to bird species would include the incremental short-term loss of potentially suitable breeding, roosting, and foraging habitat. However, this incremental loss is expected to have little effect on local bird populations based on the amount of potentially suitable breeding and foraging

and 2) human activities in and around the mine have little effect on the numbers and diversity of wildlife using these reclaimed areas (Silvy 2000). These field surveys compared morning, evening, and nighttime counts of wildlife observed at the two areas in a combination of road transects and spot counts. In general, the numbers and diversity of wildlife observed in the reclaimed areas at the Sandow Mine were comparable to or greater than the numbers and diversity observed at the Three Oaks site.

Water Level Change. This section focuses on the potential long-term, indirect impacts to wildlife species due to a potential reduction in surface water availability and potential decrease in associated riparian and wetland communities as a result of water level change in the Simsboro aquifer outcrop area. Mine-related water level changes are not expected to affect surface water sources associated with the Calvert Bluff aquifer (see Section 3.2.4.2).

As discussed in Section 3.2.4.2, a change in water level from depressurization pumping in the Simsboro aquifer potentially would reduce the surface water availability in certain intermittent gaining reaches of area streams and associated perennial pools as well as naturally occurring springs and seeps that occur within the 10-foot drawdown area of the Simsboro aquifer outcrop. Riparian/wetland habitats that are associated with affected spring, seeps, and/or gaining stream reaches could be affected by water level change (see Section 3.2.4.2). Based on groundwater modeling, the maximum extent of these potential effects to surface water availability and the associated riparian/wetland communities could continue for approximately 40 years (anticipated 90 percent groundwater recovery) to 100 years (anticipated 100 percent recovery) following the completion of mining (see Section 3.2.3.2).

The potential loss or reduction in available surface water as a result of water level change could result in long-term changes in wildlife habitats where the water sources are hydraulically connected to the Simsboro aquifer outcrop. The habitats associated with naturally occurring springs, seeps, and intermittent stream reaches and associated perennial pools encompass riparian vegetation (both woody and herbaceous plant species), wetland areas, and mesic habitats (moist areas or wet meadows). Reduction or loss of approximately 352 acres of riparian and wetland habitats associated with these water sources would impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure, as discussed below. However, based on Alcoa's proposed reclamation procedures, long-term impacts to riparian habitats and surface water sources would be minimized by the development of approximately 895 acres of surface water features and an associated 379 acres of riparian habitat within the mine area (see Section 2.5.3, Closure and Reclamation) net increase of approximately 30 acres of riparian and wetland habitat and approximately ~~825~~ ***817*** acres of surface water sources. Some of these restored habitats would be similar to pre-mining conditions and others would be different.

Naturally occurring seeps, springs, and intermittent gaining reaches provide important wildlife habitat in the study area. Riparian habitat and its associated plant communities contribute to a greater wildlife species diversity, compared to the adjacent upland areas. Since surface water and the associated riparian habitat are limiting factors for wildlife in study area, the loss of these habitat features would alter the available habitat for species that depend on these riparian areas, resulting in: 1) a reduction of available water for consumption; 2) a reduction in riparian vegetation for breeding, foraging, and cover; 3) reduction in the regional carrying capacity; 4) displacement and loss of animals; 5) a reduction in the overall biological

diversity; 6) a potential long-term impact to the population numbers of some species; and 7) reduction in prey availability. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use; species' sensitivity (i.e., level of dependency on riparian areas); and the extent of the anticipated water and riparian habitat reductions.

Due to the limited amount of riparian communities within the study area, it is assumed that species dependent upon these areas are currently at carrying capacity. Consequently, some species that are displaced due to the reduction of surface water or riparian vegetation may be able to move into adjacent areas; however, it is assumed that these adjacent riparian habitats are already at their full carrying capacity and would not support additional animals. Therefore, some individuals would be lost from the population, concentrating the remaining animals within smaller habitat areas. However, it is assumed that wildlife would reoccupy the mine area following the development of surface water features and riparian habitats within the mine area as identified in Alcoa's reclamation procedures (see Section 2.5.3, Closure and Reclamation), although species competition and population numbers may not represent what was present prior to project construction. It is assumed that reestablishment of a given wildlife species in the reclaimed area would be dependent on successful reclamation and the species ability to move to adjacent habitats, especially for the smaller, less mobile species.

Species likely affected by reductions in perennial water sources and associated habitats would include big game, upland game birds and mammals, waterfowl, nongame birds (e.g., raptors and passerines), mammals (e.g., bats), reptiles, amphibians, and fish. The extent of these indirect effects from the mine's dewatering activities would depend on the species' use and relative sensitivity, as discussed for each group below.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS). As a result, the effects to wildlife habitat as a result of water level changes, and the resulting effects to the species that utilize these habitats, would be the same as described in Section 3.5.2.1 of the Draft EIS.

Game Species. Big game (i.e., white-tailed deer) require water during the summer and fall periods, as well as during the winter period, as needed, to satisfy physiological requirements. The reduction or loss of existing water sources could impact white-tailed deer use and movements. Due to reduced habitat availability resulting from earlier habitat alteration in the area, as discussed above, low populations of deer currently occupy the study area, which lacks important big game corridors and key seasonal habitats. As a result, it is assumed that some individuals would be displaced due to the reduction of surface water and riparian vegetation and may move into adjacent areas that are already at their carrying capacity. These displaced individuals could be lost from the population; however, this loss cannot be quantified. Impacts to regional deer populations from the reduction of surface water and riparian vegetation would be expected to be low.

intensity and season of use, and timing of increased flows. During the life of the mine, the temporary increased availability of water and riparian vegetation downstream of the discharge points would help to offset the loss of riparian and wetland habitat in the upper reaches of these creeks as a result of groundwater drawdown. As discussed in Section 3.4, Vegetation, the cessation of mine-related discharge, in combination with watershed modifications, would result in the incremental long-term reduction of riparian and wetland habitats for area wildlife. However, the extent of these indirect effects on wildlife would depend on the species' use of the affected area and their relative sensitivity, as well as the availability of similar habitat types in the area.

Aquatic Species

Surface Disturbance. The potential effects of the Three Oaks Mine on aquatic resources are closely related to impacts on groundwater and surface water resources, which are discussed in Sections 3.2.3.2 and 3.2.4.2, respectively. Mine construction and operation would remove aquatic habitat consisting of ephemeral and intermittent streams and stock ponds. Approximately 38 miles of intermittent/ephemeral streams and 150 stock ponds would be incrementally removed during the life of the mine. In addition, approximately ~~31~~ ***39*** acres of off-channel ponds would be physically removed. Typically, these off-channel ponds are turbid, relatively shallow, and normally dry up. Due to the lack of water on a consistent basis, existing aquatic communities are mainly limited to macroinvertebrates and attached algae (periphyton) that can persist in intermittent and ephemeral streams. The removal of the stock ponds would eliminate habitat for macroinvertebrates and possibly nongame fish species. Although game fish may be present in some of the on-channel ponds, no records are known. Mine reclamation would replace pond habitat, primarily after mining is completed. In total, an estimated 895 acres of pond habitat (including the end lakes) would exist after reclamation is completed, resulting in a net increase of approximately ~~825~~ ***817*** acres of pond habitat. In general, these end lakes would be larger and deeper compared to the present ponds. The duration of impact (i.e., habitat loss) in each phased-disturbance area would be approximately 20 to 22 months, based on proposed concurrent reclamation plans. ***The end lakes would not be stocked with harmful exotic fish, shellfish, or aquatic plants, in accordance with TAC, Title 31, Part 2, Chapter 57, Subchapter A, Rule 57.111.***

Short-term, local increases in suspended sediment could occur during mining and construction of road and bridge crossings. These short-term increases in sediment could result in localized effects on macroinvertebrate communities and bottom substrate composition. Fish species, if seasonally present in intermittent streams or stock ponds, would be able to tolerate short-term increases in sediment. Sedimentation resulting from mining activity would be confined to the collection channels and sedimentation ponds. After water is detained in the ponds, suspended sediment levels would be similar to background conditions. Suspended sediment concentrations would stabilize and return to typical background concentrations after the road and bridge construction activities are completed. By implementing proper drainage design including detention ponds and erosion control measures during and after construction, the impact of potential increased sediment levels on aquatic species and their habitat would be low. Any localized increases in sediment would not affect downstream areas in Big Sandy Creek or Middle Yegua Creek that contain game fish species such as sunfishes and largemouth bass. The USACE is considering mitigation measures that would further reduce sedimentation impacts (see mitigation measures SW-2 and SW-3 in Section 3.2.4.4, Monitoring and Mitigation Measures).

Water Level Change. Depressurization of the Simsboro aquifer would result in flow reductions in the gaining reaches of the Big Sandy Creek drainage as discussed in Section 3.2.4.2. For those areas located upstream of the proposed discharge points or in separate drainages (e.g., Little Sandy Creek), there would be a reduction in aquatic habitat. These areas include Little Sandy Creek, Burlson Creek, and tributaries to Big Sandy Creek. Since habitat in these areas is currently intermittent, the affected aquatic species mainly would consist of macroinvertebrates. In areas located downstream of the proposed discharge points, any slight reduction in baseflow as a result of groundwater withdrawal would be small compared to the flow increases from mine discharge. The net change in flow in areas located below the discharge points would be an increase, which means that additional aquatic habitat would be available during the period of mine discharge. When mining is completed, a net decrease in flow would occur until the aquifer recovers, which would result in reduced habitat in portions of the Big Sandy drainage.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS). As a result, the effects to aquatic habitat as a result of water level changes would be the same as described in Section 3.5.2.1 of the Draft EIS.

Water Discharge. Discharge of mine water would result in increased flows in Big Sandy and Middle Yegua Creeks below the proposed discharge locations (**Figure 3.2-24**). The increased flow in the receiving streams would range from approximately 3.3 to 9.7 cfs in Big Sandy Creek and 13 to 18.5 cfs in Middle Yegua Creek (average flow conditions). Flow increases in these ranges would represent a substantial increase compared to base flow conditions (2- to >5-fold change). However, some of the surface water discharge may seep into the channel bed or be taken up by evapotranspiration within a few miles of the outfall, which would reduce the level of increased flow in Big Sandy and Middle Yegua Creeks. A net increase in the amount of available habitat for aquatic species would occur in stream sections located below the outfalls. The relative increase in habitat likely would result in increased numbers of fish and macroinvertebrates, particularly in those sections of the streams that presently exhibit intermittent flow. Flow increases likely would change the relative composition of riffle, run, and pool habitats. Sufficient information is not available in the affected reaches to predict the predominant types of habitat that would exist after mine discharge is initiated.

During the post-mining phase of the project, flows and the amount of aquatic habitat would decrease mainly due to watershed modifications made as part of reclamation. In addition, groundwater discharges to Big Sandy and Middle Yegua Creeks would cease at the end of mining. Although groundwater would recharge and contribute water to streams located near the Simsboro aquifer in approximately 40 years, the overall effect on flows and habitat would be a reduction due to the watershed modifications. The effect of reduced habitat on aquatic biota would be possible reductions in numbers. To determine if fish and macroinvertebrate populations are affected by drawdown and/or discharge volumes, ~~the USACE is considering monitoring for lower Big Sandy Creek (see mitigation measure FW-3 in Section 3.5.4, Monitoring and Mitigation Measures).~~***additional mitigation is identified in Table 2-15 of the Final EIS (see mitigation measure FW-3).***

The effects of discharges on water quality in Big Sandy and Middle Yegua Creeks are expected to be minor. Overall, sediment levels resulting from increased flows are expected to be within ranges exhibited during high-flow periods. No changes in aquatic communities or their habitat is expected over most of the areas receiving discharges. No changes in metals concentrations are anticipated, since discharge water would be treated by flocculation or other chemicals to meet TPDES permit requirements. The effect of discharge water on stream temperature is expected to be minor. Prior to discharge, groundwater withdrawals may be held in retention ponds, which would result in water temperatures similar to those in the receiving streams. All discharge water would need to meet TPDES permit requirements for temperature.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in minor changes to dewatering and depressurization pumpage rates (see page 2-21 of the Final EIS) as well as a related minor change in discharges to streams (see page 3.2-81a of the Final EIS). However, it is anticipated that the effects to aquatic resources would be the same as described in Section 3.5.2.1 of the Draft EIS.

toad habitat. Big Sandy Creek occurs approximately 4 miles from the Carrizo outcrop. Consequently, Big Sandy Creek is very unlikely to provide habitat for Houston toads, and potential changes in the flow regime of the creek are not expected to indirectly impact the species.

Middle Yegua Creek, which drains the northern portion of the permit area, does not intersect the Carrizo Formation; Middle Yegua Creek occurs within an alluvial floodplain that bisects the Carrizo Formation approximately 5 miles downstream of the project's water discharge points. It is unlikely that Houston toads or potential breeding habitat for this species would be impacted as a result of surface water discharge over the 25-year life of the mine. This assessment is based on the expected distance of flow alteration (4 to 6 miles downstream from the discharge points, as discussed in Section 3.2.4.2) relative to where the alluvial floodplain bisects the Carrizo outcrop, and the limited amount of potentially suitable Houston toad habitat within the alluvial floodplain. The alluvium within this floodplain does not contain appreciable amounts of deep sandy soils that is typical habitat for this species, and much of the woodland habitat within the floodplain area previously has been modified for pasture use. However, in the event that flow alterations were to reach the Carrizo outcrop, and suitable breeding habitat conditions for the Houston toad (i.e., still or slow-flowing water bodies) were present, alterations in the flow regime potentially could impact individuals and breeding/nursery sites within or adjacent to the main-stem of Middle Yegua Creek that may experience elevated base flows, reduced peak flows, and more sustained flows. Although Houston toads have not been documented to occur within the Middle Yegua Creek alluvial floodplain and are not known to utilize flowing main-stem creek channels for breeding or egg laying purposes, this species may utilize adjacent off-channel still or slow-flowing wetlands or other hydric areas (e.g., tributaries, ponds, rain pools, flooded fields) that may provide more suitable breeding habitat for Houston toads within close proximity to the Carrizo outcrop. Consequently, if flow alterations were to reach the alluvial floodplain of Middle Yegua Creek and suitable Houston toad habitat and individuals were present, potential impacts could include the loss of egg masses and young. However, based on the lack of appreciable amounts of suitable Houston toad habitat within the alluvial floodplain and the potential for flow alteration at the Carrizo outcrop, potential impacts to the Houston toad, if present, would be anticipated to be low.

Timber/Canebrake Rattlesnake. Direct impacts to the timber/canebrake rattlesnake from surface disturbance would result in the temporary loss of potentially suitable habitat, including approximately 352 acres of riparian habitat, which would have the highest likelihood of supporting this species in the permit area. However, it is anticipated that most of the riparian woodlands that would be impacted would be affected incrementally over the 25-year life of the mine. These impacts would be minimized, based on the proposed reclamation procedures that would include the establishment of fish and wildlife habitat, 3,451 acres of which potentially would be suitable for this species. Included in this acreage would be 379 acres of riparian corridor (see Section 2.5.3). In addition, ~~approximately 20.6 acres of~~ ***offsite*** riparian habitat would be enhanced at the Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site***. However, it is not clear what portion of reclaimed lands may provide potential habitat for rattlesnakes or whether rattlesnakes would successfully occupy these areas. Direct impacts to the timber/canebrake rattlesnake from surface disturbance also may result in the loss of individuals, if present. In order to minimize potential impacts to individual rattlesnakes, Alcoa has committed to implementation of their current protection plan for the timber/canebrake rattlesnake at the Sandow Mine for the proposed Three Oaks Mine. These protection measures would include employee awareness and education, and the relocation of individual rattlesnakes found in the disturbance area to nearby suitable habitat outside the mine area.

Based on the committed protection measure, these actions are unlikely to cause more than minimal adverse impacts to this species. ***Additional mitigation is identified in Table 2-15 of the Final EIS that would evaluate the survivability of relocated rattlesnakes (see mitigation measure FW-4).***

Potential indirect impacts to the timber/canebrake rattlesnake as a result of groundwater drawdown would include the incremental long-term reduction of riparian habitat along gaining stream reaches within the 10-foot or greater drawdown area of the Simsboro outcrop, although these areas are less likely to support this species than the riparian habitat that is associated with the permit area. Consequently, effects to this species as a result of water level changes in the Simsboro outcrop are expected to be low.

No potential impacts to the timber/canebrake rattlesnake as a result of surface water discharge to Big Sandy Creek or Middle Yegua Creek would be anticipated during the 25-year life of the mine. In fact, increased flows may enhance riparian habitat over the life of the mine. Indirect impacts during the post-mining phase of the project would result from the incremental reduction of enhanced riparian habitat along these creeks for a distance of 4 to 6 miles as a result of watershed modifications and water level changes in the Simsboro aquifer (see Section 3.4.2.1 under Vegetation). Although potential impacts to this species as a result of watershed modifications and water level changes could result in a reduction of riparian habitat along 4 to 6 miles of these creek segments, potential impacts partially may be offset by the development of approximately 379 acres of riparian habitat near developed surface water features in the permit area and the enhancement of ~~approximately 20.6 acres of~~ ***offsite*** riparian habitat at the Middle Yegua Mitigation Site ***and Big Sandy Mitigation Site***. Consequently, potential impacts to this species during the post-mining phase of the project are expected to be low.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels, as described on page 2-21 of the Final EIS, would not change the projected mine-related groundwater drawdown in the Calvert Bluff or Simsboro aquifers (see pages 3.2-27 and 3.2-28 of the Final EIS) and would result in a minor decrease in disturbance area for the riparian woodland habitat type (see page 3.4-11 of the Final EIS). As a result, the potential impacts to this species as a result of water level change effects on the riparian habitats along gaining stream reaches within the mine-related drawdown area and mine-related surface disturbance in riparian woodland habitats would be the same as described in Section 3.5.2.1 of the Draft EIS.

Texas Horned Lizard. Potential direct impacts to the Texas horned lizard from surface disturbance within the permit area could occur, particularly where sandy soils and grassland and/or mesquite grassland occur. Direct impacts to this species also could result in the direct loss of individuals from mine development, if present. This species has not been identified in the permit area to date; however, Alcoa has committed to developing and implementing protection measures, in coordination with the jurisdictional agencies, that would reduce potential impacts to the Texas horned lizard, if the species is observed in the disturbance area. Based on Alcoa's committed protection measure and the wide distribution of this species within the state, it is expected that the Proposed Action unlikely would result in more than minimal impacts to the Texas horned lizard.

No impacts to the Texas horned lizard as a result of water level changes or surface water discharge would be anticipated based on the dry grassland and mesquite grassland habitats that this species occupies.

If the four uncontrolled parcels in the eastern and southern portions of the proposed mine disturbance area and the one uncontrolled property at the southern end of the transportation/utility corridor cannot be obtained by Alcoa, the modification in the disturbance area to accommodate these parcels, as described on page 2-21 of the Final EIS, would result in minor changes in the disturbance acreages as identified for the grassland and mesquite grassland habitats (see Table 3.4-2 of the Draft EIS) utilized by this species. However, the overall effects to the Texas horned lizard would be the same as described in Section 3.5.2.1 of the Draft EIS.

and bald eagles to find food during migration. Therefore, potential impacts to these species as a result of surface disturbance is considered to be low.

Final reclamation of the mine area would result in the presence of two end lakes with a combined surface area of approximately 722 acres (Section 3.2.4.2 under Surface Water). Waterbodies of this size ultimately could support waterfowl, shorebirds, and fish in sufficient concentrations to attract and support migrating, and possibly even wintering, peregrine falcons and bald eagles. The total number of falcons or eagles utilizing the end lakes in any given year would be expected to be low. As a result, the benefit to these species as populations likely would be negligible; however, the lakes could provide a slight positive benefit to individual falcons or eagles.

The effects of mine water discharge and water level changes are not expected to result in habitat changes that would change the availability of food resources for falcons or eagles within this area. Therefore, potential impacts to these species as a result of water level change and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek would be low.

Whooping Crane. No direct impacts to nesting whooping cranes would occur from the construction and operation of the Proposed Action. Although it is possible that migrating whooping cranes occasionally could utilize grasslands within the permit area during migration, the grasslands that occur within the permit area generally are distributed within a mosaic of brushy and woody vegetation that does not provide typical habitat for whooping cranes (see **Figure 3.4-1**). However, the loss of potentially suitable stop-over habitat within the permit area would be offset through Alcoa's proposed reclamation plan to create ~~3,031~~ ***2,996*** acres of pastureland, 70 acres of cropland, and mitigate for wetlands at a ratio of 2:1. Therefore, the reclaimed lands likely would be as suitable or more suitable for migrating cranes than habitat that currently exists in the permit area. Consequently, the temporary loss of grasslands from the permit area is not likely to adversely impact the species.

Potential surface water discharge and water level effects within the permit area also are not expected to adversely impact the whooping crane. Surface water discharge and water level changes within the permit area may result in some localized changes in vegetation composition along some stream channels; however, they are not expected to result in substantial landscape changes. Therefore, no change in the present level of potentially suitable stopover habitat available to whooping cranes in the study area is expected.

Wood Stork. Surface disturbance would result in the loss of approximately 150 stock ponds that provide potentially suitable habitat for this species during post-breeding dispersal. Based on the proposed reclamation procedures that would be implemented concurrently with mining, there would be a net increase of approximately ~~825~~ ***817*** acres of potentially suitable habitat (e.g., ponds and end lakes) following the completion of mining and reclamation. Based on the availability of potential habitat at other stock ponds and lakes in the region and the net increase in potentially suitable habitat in the permit area, the potential for adverse impacts to this species would be low.

Indirect adverse impacts to the wood stork could result in the incremental long-term reduction of riparian and wetland habitats along gaining stream reaches as a result of water level changes within the 10-foot or

greater drawdown area of the Simsboro outcrop. However, these incremental habitat changes would be offset by the development of approximately 379 acres of riparian habitat and approximately 895 acres of surface water habitat in the permit area. Consequently, potential impacts from water level changes are expected to be low.

No potential impacts to the wood stork as a result of surface water discharge to Big Sandy Creek or Middle Yegua Creek would be anticipated during the 25-year life of the mine. As discussed above for the timber/canebrake rattlesnake, increased flows may improve riparian habitat over the life of the mine. Indirect impacts during the post-mining phase of the project would result in an incremental reduction of enhanced riparian and wetland habitats along these creeks for a distance of 4 to 6 miles as a result of watershed modifications and water level changes in the Simsboro aquifer (see Section 3.4.2.1 under Vegetation). Although potential impacts to this species could result from watershed modifications and water level changes, potential impacts would be overshadowed by the development of riparian and surface water habitats in the permit area and enhancement of riparian habitat at the Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site***. Consequently, potential impacts to this species during the post-mining phase of the project are expected to be low.

If the four uncontrolled parcels in the eastern and southern portions of the mine area cannot be obtained by Alcoa, the modification in the mine area to accommodate these parcels would result in minor changes to dewatering and depressurization pumpage rates (see page 2-21 of the Final EIS) as well as a related minor change in discharges to streams (see page 3.2-81a of the Final EIS). However, it is anticipated that the effects to riparian and wetland habitats, and associated impacts to the wood stork, would be the same as described in Section 3.5.2.1 of the Draft EIS.

Species of Special Concern

Leonora's Dancer. Potential direct impacts to the Leonora's dancer from surface disturbance would include the incremental short-term loss of approximately 23.6 acres of ephemeral and intermittent stream channels, 69.9 acres of ponds, and 5.3 acres of wetlands that may support suitable habitat for this species. The loss of these water features would occur incrementally over the life of the mine and concurrently with project reclamation. As a result, the potential long-term loss of habitat would be offset by the development of 895 acres of aquatic habitat and 379 acres of riparian habitat in the mine area following reclamation. In addition, ~~approximately 20.6 acres of~~ riparian habitat would be enhanced at ***both*** the Middle Yegua Mitigation Site ***and the Big Sandy Mitigation Site (see Appendix E of the Final EIS)***. It is possible that some of these water features could provide potential habitat for Leonora's dancer should this species occur in the permit area. If construction were to occur during the breeding season (see **Table F-4** in Appendix F), direct impacts could include the possible loss of breeding adults, eggs, and larvae, if present. However, because the likelihood of this species occurring within the permit area is low, potential impacts to the Leonora's dancer from surface disturbance also would be low.

Indirect adverse impacts to the Leonora's dancer, if present, could occur as a result of groundwater drawdown in the Simsboro aquifer. The water level changes in the 10-foot drawdown area of the outcrop would ~~result in the incremental long term loss of 11.5 acres of ephermeral and intermittent stream habitat and 5.2 acres of wetland habitat, if present~~***not affect potential populations occurring along ephemeral streams, as these areas are sustained solely by surface runoff. However, habitat and potential***

populations associated with gaining reaches of intermittent streams and portions of the 5.3 acres of wetlands that receive hydrologic contribution from the Simsboro aquifer may be adversely affected. ~~However,~~ The potential long-term loss of ***this*** habitat would be offset through the development of aquatic and riparian habitat during reclamation, as discussed above. Potential increases in the flow of Big Sandy Creek and Middle Yegua Creek from surface water discharge potentially could impact the Leonora's dancer by affecting aquatic habitat availability in segments of these creeks, if present. However, these flows also may benefit this species in the short-term by creating more aquatic habitat in these streams during mining. Although post-mining water levels within the creeks may result in the loss of some aquatic and wetland habitats compared to conditions during mining, these losses are not expected to substantially change the suitability of these creeks for the Leonora's dancer relative to baseline conditions along these stream channels. Consequently, potential impacts to the Leonora's dancer as a

result of water level changes and surface water discharge are unlikely to adversely impact Leonora's dancer. The stream segments that potentially would be impacted are intermittent. Most damselfly nymphs are associated with permanent waters, though some are adapted to temporary or even semi-aquatic environments (Merritt and Cummings 1984). As it is uncertain if Leonora's dancers occur in this area, and these intermittent streams are not typical habitat for most damselfly nymphs, it is unlikely that water level changes in the Simsboro aquifer would adversely impact the species.

Guadalupe Bass. The impact assessment for this species would be similar to the blue sucker. No impacts to the Guadalupe bass would be anticipated as a result of surface disturbance, water level changes, or water discharge from mine-related activities. This assessment is based on the unlikely potential that this species would occur within the permit area, within portions of streams that may be impacted by water level changes in the Simsboro aquifer, or within the segment of Middle Yegua Creek that would receive water discharge from the permit area. Changes in the flow regime of Big Sandy Creek as a result if water discharge could potentially result in a benefit to fishes that occur in the Colorado River including this species. Following the cessation of mine-related water discharge, potential changes in the flow regime of Big Sandy Creek are anticipated to have a negligible effect on the Colorado River. Consequently, no impacts from water discharge into Big Sandy Creek would be anticipated for the Guadalupe bass.

Texas Garter Snake. Potential impacts to the Texas garter snake from surface disturbance, water level changes, and mine water discharge are expected to be low based on the location of the study area outside of the known range of the snake, the general lack of typical aquatic and riparian habitats within the permit area, and the uncommon occurrence of this snake within its known range. Therefore, while it cannot be ruled out that surface disturbances, water level changes in the Simsboro aquifer, and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek may result in impacts to a few individuals, these actions are unlikely to cause more than minimal adverse impacts to this species.

Henslow's Sparrow. Because of the irregularity of expected occurrence and the general scarcity of this species in the permit area, mine-related surface disturbance is not expected to cause adverse impacts to this species.

Surface water and groundwater effects are not expected to result in substantial changes to potential Henslow's sparrow wintering habitat, as such habitat typically occurs away from drainage channels. Therefore, Simsboro aquifer water level changes and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek are not likely to adversely impact the species.

Reclamation of mined areas would result in the creation of ~~4,520~~ ***4,550*** acres of wildlife habitat and ~~3,031~~ ***2,996*** acres of pastureland, portions of which may provide potentially suitable habitat for this species. However, due to the rarity of Henslow's sparrow in the region and the distance of the permit area from primary wintering areas, development of potentially suitable habitat is expected to have negligible benefit to the species.

Loggerhead Shrike. Potential impacts to the loggerhead shrike as a result of surface disturbance in the permit area are expected to result from the incremental short-term loss of habitat for this species. Of the vegetation types present in the permit area, those described as grassland, mesquite grassland, and upland woodland could provide habitat for loggerhead shrikes. These vegetation communities make up

approximately 95 percent of the permit area (see Section 3.4.1 under Vegetation). Loggerhead shrikes are unlikely to occur in all areas supporting these communities, either because some areas are likely too open or too heavily wooded. However, in a conservative scenario, assuming that these habitat types are equally distributed throughout the permit area, 8,209 acres of the approximately 8,654 acres proposed to be disturbed could provide habitat for loggerhead shrikes. Depending on the time of year, land-clearing activities could result in the loss of nests, eggs, or young. However, direct impacts to active nests would be minimized by Alcoa's committed protection measures to clear vegetation outside of the breeding season or conduct breeding bird surveys within potentially suitable habitat prior to construction from February 28 through July 31, as discussed above for nongame bird species. Disturbed areas would be reclaimed concurrently with mining, and these areas are expected to provide suitable habitat for loggerhead shrikes. Because shrikes prefer relatively open habitats, reclaimed areas could begin supporting shrikes shortly after reclamation. Consequently, potential impacts to this species as a result of disturbance are expected to be low.

Potential surface water and groundwater effects are not expected to result in substantial landscape changes and, therefore, are not expected to change the quality of habitats in the area with regard to suitability for the species. Therefore, water level changes in the Simsboro aquifer and potential changes in the flow regimes of Big Sandy Creek and Middle Yegua Creek are not expected to adversely impact the species.

Reddish Egret. No potential impacts to the reddish egret as a result of surface disturbance, water level changes, or mine water discharge from the project are anticipated, because the reddish egret does not breed or occur regularly in the permit area.

White-faced Ibis. Surface disturbance in the permit area would result in the temporary, incremental loss of approximately 150 stock ponds (Section 3.2.4.2 under Surface Water). Many of these ponds likely provide small amounts of appropriate habitat for white-faced ibis. However, similar ponds are abundant throughout the region, and, as the loss of these features would occur incrementally, the loss of these ponds is expected to have a negligible effect on availability of resources for migrating or wandering white-faced ibises. Therefore, surface disturbances would not adversely impact this species.

The effects of mine water discharge and water level changes are not expected to affect the white-faced ibis. These activities may result in some localized changes in vegetation composition along some stream channels but would not effect the ponds in the areas where ibises could potentially occur.

Mine reclamation would result in a net increase of approximately ~~825~~ ***817*** acres of aquatic habitats. These waterbodies would likely develop marshy edges in some areas that could provide potentially suitable habitat for migrating or wandering white-faced ibises.

Elliot's Short-tailed Shrew. The potential for impacts to Elliot's short-tailed shrew resulting from surface disturbance and water level changes within the permit area is low based on the unlikelihood that this sub-species occurs within the permit area. Potential surface water and groundwater effects, including Simsboro aquifer drawdown and potential changes to the flow regimes of Big Sandy and Middle Yegua Creeks, are not expected to result in landscape changes, and therefore, are not expected to change the quality of potential shrew habitats within the study area.

Special Status Species and Species of Special Concern

No mine-related impacts associated with surface disturbance, water level changes, or surface water discharge would occur to special status species or species of special concern under this alternative.

3.5.2.3 Alternative Mine Plan

Under the Alternative Mine Plan, potential mine-related impacts to terrestrial and aquatic wildlife species, including special status species and species of special concern, as a result of surface disturbance, water level change, and water discharge would be the same as described for the Proposed Action (see Section 3.5.2.1 of the Draft EIS).

3.5.3 Cumulative Impacts

3.5.3.1 Three Oaks without SAWS

Terrestrial Species

Surface Disturbance. The cumulative effects area for surface disturbance examined for wildlife resources included the Three Oaks Mine, Sandow Mine, Powell Bend Mine, the Rockdale power generating station and Rockdale aluminum smelter, and clay mining and brick manufacturing facilities near Butler and Elgin in Bastrop County.

As discussed in Section 3.4.3 under Vegetation, an area of approximately 8,654 acres would be disturbed over the projected life of the Three Oaks Mine. In accordance with RRC guidelines, approximately 7,635 acres would be revegetated including ~~4,520~~ ***4,550*** acres of fish and wildlife habitat. In addition, 895 acres would be reclaimed as ponds and end lakes (a net increase of approximately ~~825~~ ***817*** acres). The Sandow Mine will disturb approximately ~~15,103~~ ***15,108*** acres, of which 14,331 acres would be revegetated, ***30 acres left as industrial/commercial,*** and the remaining ~~772~~ ***747*** acres would be reclaimed as ponds and end lakes (a net increase of approximately ~~654~~ ***589*** acres of aquatic habitat). The Powell Bend Mine has disturbed approximately 291 acres and is currently being reclaimed in accordance with RRC criteria. Other surface disturbance activities within the cumulative effects area include the previous removal of approximately 100 acres and 275 acres at the Rockdale power generating station and the Rockdale aluminum smelter, respectively. Also, approximately 895 acres of terrestrial habitat has been lost due to development of Alcoa Lake in association with the Rockdale facilities, and approximately 900 acres of terrestrial habitat has been converted to form Lake Bastrop for the Lost Pines Power Park. In addition, of the 1,355 acres that is privately owned by the clay mining and brick manufacturing facilities near Butler and Elgin, 1,000 acres have previously been disturbed. For purposes of this analysis, it is assumed that 50 percent (500 acres) of this disturbance will be reclaimed.

Overall, cumulative impacts for the interrelated projects would parallel those discussed for the proposed project. Consequently, the cumulative effects to wildlife resources would be directly related to habitat loss or alternation, fragmentation, and animal displacement that have primarily resulted from the interrelated projects as well as the alteration of native habitats into pastureland and cropland in the project area. Habitat loss or alteration would result in direct losses of smaller, less mobile wildlife species (e.g., small mammals and reptiles), and the displacement of more mobile species into adjacent habitats that may currently be at or

23,132 acres) eventually would be revegetated, with much of the remaining acreage reclaimed to surface water features (i.e., ponds and end lakes). Based on a combined ~~188~~ ***195*** acres of previously existing surface water features, there would be a cumulative increase in aquatic habitat of approximately ~~3,274~~ ***3,267*** acres. Although wildlife populations that occur in the cumulative effects area would continue to occupy their respective habitats and breed successfully, species composition population numbers may change relative to the amount of cumulative habitat loss and disturbance from the incremental development. Although subsequent reclamation would restore habitats to specified post-mining land-uses, it is expected that all reclaimed areas would be capable of supporting wildlife; however, species' composition and densities would be expected to change. Revegetated areas would be planted with species appropriate to the proposed post-mining land uses, but natural processes of species competition and survival will modify these communities over time (see Section 2.5.3, Closure and Reclamation). Thus, it is expected that vegetation communities on reclaimed areas will gradually evolve to more closely resemble the surrounding undisturbed communities, leading to similar gradual changes in the wildlife populations using these areas.

Water Level Change. The projected water level change from mining activities and municipal pumping would result in a reduction in the amount and extent of available surface water (e.g., streams, seeps, and springs) and associated riparian, wetland, and mesic habitats for area wildlife. In the cumulative effects area, municipal pumping would reduce flows in the Big Sandy and Middle Yegua drainages; however, the greatest impacts would occur along Big Sandy Creek, based on its location in relation to the Simsboro aquifer outcrop. Flow reductions in Big Sandy and Middle Yegua Creeks would result in the long-term loss of perennial pools and mesic habitats that occur in the affected reaches of these drainages. Reduced flows in the Big Sandy and Middle Yegua drainages, in combination with the effects of water level change on seeps and springs, would result in the incremental long-term reduction of riparian and wetland habitats, available surface water for area wildlife. Potential loss or reduction of available water or possible long-term effects to the riparian and wetland communities could result in the loss of cover, breeding and foraging habitats, reduction in available water for consumption, increased animal displacement and loss, reduction in the overall biological diversity, a reduction in the area's carrying capacity for terrestrial wildlife, and possible population declines, depending on the level of effects and the relative species' sensitivity.

Loss or reduction of perennial pools and riparian and wetland habitats would reduce the regional carrying capacity for terrestrial wildlife (i.e., the region located within the cumulative drawdown area would support a lower diversity and reduced number of riparian- and wetland-dependent wildlife species). Animals that use perennial water sources would be displaced as the available water and riparian and wetland vegetation declines. Assuming that these limited communities are currently at their respective carrying capacities, individuals that are displaced into adjacent communities may be lost from the population, concentrating the remaining animals within smaller habitat areas.

Species likely impacted by the reductions of perennial pools and riparian and wetland habitats would include big game, upland game birds, waterfowl, raptors, songbirds, nongame mammals, and area amphibians and reptiles. The extent of these indirect effects from water level change would depend on the species' use and relative species' sensitivity.

Although some recovery of the Simsboro aquifer is expected to occur following the termination of mine-related groundwater drawdown in the vicinity of the Three Oaks Mine, drawdown from continued

3.5.4 Monitoring and Mitigation Measures

FW-1: Raptor Collision Protection. Standard raptor-proofing designs, as outlined *in Mitigating Bird Collision with Power Lines* (APLIC 1994), would be incorporated into the design of the new and relocated power lines and new substation, as applicable, to prevent the potential collision to foraging and migrating bird species (i.e., raptors and waterfowl) in the project area.

FW-2: Raptor Electrocution Protection. Standard safe designs, as outlined in Suggested Practices for Raptor Protection on Power Lines (APLIC 1996), would be incorporated into the design of the relocated 14.4-kV power line and the new 25-kV power distribution lines in areas of identified avian concern to prevent electrocution of raptor species attempting to perch on the lines. These measures would include, but would not be limited to, a 60-inch separation between conductors and/or grounded hardware and recommended use of insulating materials and other measures depending on line configuration (APLIC 1996).

FW-3: Aquatic Monitoring. ~~To determine if fish and macroinvertebrate populations are affected by drawdown and discharge volumes, aquatic biology monitoring is recommended on lower Big Sandy Creek. If substantial reductions in fish and macroinvertebrate numbers are indicated, Alcoa would manage groundwater discharge to increase the volume released into Big Sandy Creek. Alternately, if groundwater pumping for SAWS should be implemented, it is assumed that CPS would be responsible for similar monitoring and mitigation.~~ ***Alcoa would perform aquatic monitoring of fish and macroinvertebrate organisms at one location each upstream and downstream of the mine outfalls on Middle Yegua Creek. A description of the proposed monitoring follows:***

Sample collection and analyses would be performed according to TCEQ guidelines as outlined in their 1999 Receiving Water Assessment Procedures Manual. The data collected for these samples would be adaptable to the application of statewide and regional metric scoring for aquatic life use.

For fish, sampling would include 15 minutes of electro-shocking and six 60-meter seine hauls per station.

For benthos, three qualitative kicknet samples would be collected per station per TCEQ guidelines.

For quantitative benthic assessment in shallow water, three subsamples would be collected at each station utilizing a surber sampler.

For quantitative benthic assessment in deeper water, three subsamples utilizing an Ekman dredge would be collected at each station.

Fish and benthic samples would be collected from the two station areas during the spring and fall seasons for the first 3 years once mining begins. If, after 3 years, it can be determined that a single spring season sample would represent the sample station areas adequately and no mining effects have been noted, only spring sampling would be continued. If substantial reductions in fish and macroinvertebrate numbers are indicated, Alcoa would manage groundwater discharge, as feasible, to increase the volume released into Middle Yegua Creek.

FW-4: Cooperative Radio-telemetry Study with TPWD. Alcoa would coordinate with TPWD, and with TPWD approval would participate in, radio-telemetry studies to determine survivability of relocated timber/canebrake rattlesnakes within the Three Oaks Mine and Sandow Mine permit areas and in Bastrop State Park. In general, the study would require that timber/canebrake rattlesnakes captured within the Three Oaks Mine permit area receive radio-telemetry transmitter implants and be released at locations identified in the study plan; potential release sites would include non-impacted areas within the Three Oaks Mine permit area, non-impacted areas within the Sandow Mine permit area, and Bastrop State Park. The movements and survival of the relocated rattlesnakes would be monitored utilizing radio-telemetry receiver equipment. Alcoa's participation in the cooperative study could include allowing supervised access to portions of the Three Oaks Mine and Sandow Mine permit areas; directing employees and/or consultants to participate in study efforts; and contributing funds to be used for purchasing and maintaining equipment, purchasing and maintaining supplies, and/or supporting research personnel.